SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JULY, 1931.

GENERAL PHYSICS.

2134. Twenty-First Annual Exhibition of the Physical and Optical Societies. *Journ. Sci. Instruments,* 8. *pp.* 53–57 *and* 75–80, *Feb.,* 1931.—Notes on Exhibits: " Research and Experimental Section," by **E. N. da C. Andrade**; " Meteorological Instruments," by **J. S. Dines**; " Physiological Apparatus," by **D. T. Harris**; " Educational Apparatus and Experiments," by **C. G. Vernon.**

2135. Free Damping of an Aerofoil Pendulum Immersed in a Fluid. E. Tyler. *Phil. Mag.* 11. *pp.* 570–578, *Feb.,* 1931. *Supplement.* —This problem has been investigated for varying depths of water and at different angles of inclination $\theta°$ to the plane of vibration. The results show that the natural period of vibration of the pendulum as determined in air is very little affected by immersing the pendulum in the fluid. If λ_0, λ_{θ_1}, and λ_{θ_2} are the logarithmic decrements at $\theta = 0$, $\theta_1°$ and $\theta_2°$ at constant depth of immersion d cm., and b and D = the width and maximum thickness of the aerofoil respectively, then

$$(\lambda_{\theta_2} - \lambda_0)/(\lambda_{\theta_1} - \lambda_0) = (b \sin\theta_2 - \mathrm{D})/(b \sin\theta_1 - \mathrm{D}).$$

Furthermore, if λ_0, λ_1, λ_2 and λ_d are the logarithmic decrements at a given inclination θ, for depths of immersion 0, d_1, d_2, and d cm., $\lambda_d - \lambda_0 = \mathrm{K}d$, where $\lambda_d < 0\cdot10$ (K = const.), and $(\lambda_2 - \lambda_0)/(\lambda_1 - \lambda_0) = (d_2/d_1)^2$ when $\lambda_d > 0\cdot10$ for excessive damping. H. H. Ho.

2136. Motion of a Pendulum in a Viscous Medium. G. W. Brindley and T. Emmerson. *Phil. Mag.* 11. *pp.* 633–642, *Feb.,* 1931. *Supplement.*—The validity of Stokes' theory of the motion of a pendulum with a spherical bob in a viscous medium is established. At amplitudes greater than 0·5 cm., for pendulums varying in length from 200–500 cm., the logarithmic decrement decreases as the amplitude decreases, but for amplitudes less than 0·2 cm. it is constant, as required by Stokes' theory. When correction is made for damping due to the suspending wire, the value for the viscosity of water, derived by applying Stokes' theory agrees with the generally accepted value. The variation of the logarithmic decrement at amplitudes greater than 0·5 cm. is possibly attributable to the suspension wire. The modified theory due to Hoare [see Abstract 2716 (1930)] is considered to be invalid. J. S. G. T.

2137. Surface Tensions of Aqueous Solutions of p-Toluidine. R. C. Brown. *Phil. Mag.* 11. *pp.* 686–690, *March,* 1931.—Gans and Harkins, using the drop weight method, have obtained results which are widely different from those of Edwards, who used Ferguson's modification of the capillary rise method. In his paper, Edwards remarked that a few points determined by the use of the ring method as embodied in the du Noüy tensiometer did not lie on his curve. The present author accordingly has employed several methods, *viz.*, ring, rectangular film, Ferguson, capillary rise and pull on a sphere, and the results obtained from all are in fairly close agreement with those of Gans and Harkins. The fact that the values obtained by the two methods which depend on contact angle—namely, capillary rise and Ferguson's method—are near to those given by methods independent of contact angle shows that the angles of contact between the various solutions and glass in air must be sensibly zero. H. H. Ho.

2138. Hydrodynamical Problem: Motion due to a System of Bodies. H. Sircar. *Calcutta Math. Soc., Bull.* 22. *pp.* 171–198, *Dec.*, 1930.—The translation of two circular discs in an infinite liquid is considered, Nicholson's method being followed [see Abstract 1306 (1925)] and an integral equation obtained which is solved approximately. Following this, an investigation of the rotation of two circular discs, equal and unequal, in a viscous liquid is given. In the case of unequal discs, a method of approximation is followed, whilst in the case of equal circles, the method of approximation as well as that of integral equation is introduced. The Fourier-Bessel integral of spheroidal harmonics is necessary, and a general formula is obtained which includes Bauer's formula as a special case and which proves more suitable than that obtained by the Nicholson method of deriving the integral when applied to spheroidal harmonics of zonal types. H. H. Ho.

2139. Bi-Dimensional Applications of the Cavitational Theory of Riabouchinsky. B. Demtchenko. *Comptes Rendus*, 192. *pp.* 272–274, *Feb.* 2, 1931.—In the present paper two typical cases of cavitation are considered which are produced (*a*) by the sudden motion of a solid from rest, an infinite circular cylinder of unit radius being taken as the example, and (*b*) by the same cylinder in uniform motion, the external pressure diminishing abruptly. The distributions of acceleration, pressure and resistance to motion through the liquid are studied and numerical cases cited. In order to make the problem physically possible, the liquid is assumed to be limited by a free surface at a given distance which is subjected to uniform pressure. The mathematical methods have been previously given. [See Abstract 2999 (1930).] H. H. Ho.

2140. Initial Motion of a Mass of Liquid. G. Bouligand. *Comptes Rendus*, 192. *pp.* 403–404, *Feb.* 16, 1931.—In a discussion of the theory of cavitation developed in a previous paper [see Abstract 1751 (1931)], the author suggests that there occurs a state of motion intermediate between that satisfying the condition of hydrodynamic continuity and the state of total disintegration of the fluid. J. S. G. T.

2141. Steady Motion in a Heavy Fluid. H. Poncin. *Comptes Rendus*, 192. *pp.* 543–546, *March* 2, 1931.—This paper, which is entirely mathematical, continues previous work [see Abstract 3916 (1930)] on the flow of a liquid in a channel. The steady irrotational flow in a channel whose boundaries are undefined curves is treated in a generalised manner. J. P. A.

2142. Stability of Motion of Rectilinear Vortices in Ring Formation. T. H. Havelock. *Phil. Mag.* 11. *pp.* 617–633, *Feb.*, 1931. *Supplement.*—The stability of a finite number of vortices equally spaced round the circumference of one or more concentric rings is discussed. The equations for the general case of a single ring of *n* vortices are shown to yield a single explicit solution; a ring of seven vortices is characterised by neutral stability for small displacements; with less or more than seven vortices the stability is completely stable or unstable respectively. The effect of an assigned velocity field upon the stability is briefly discussed. If the fluid rotates like a rigid body the conditions for stability are unaffected. If there is an assigned vortex fixed at the origin, then the steady state of motion can be made stable. The effect of an external or internal concentric boundary upon the stability of a single ring is then discussed, and it is shown that, in either case, the stability is diminished, seven or more vortices in the ring being unstable, whatever the radius of the boundary. For a smaller number of vortices there is a limiting ratio of the radius of the ring to the radius of the boundary for stability in each case. For an external boundary the motion is unstable in any case if the radius of the boundary is less than about twice the radius of the ring. A similar result holds for an internal boundary. Finally, the motion of two concentric rings of vortices, of opposite rotations, spaced alternately, is discussed. A steady state is possible in which the rings rotate and retain their relative positions unaltered, but there are always modes of disturbance which produce instability. By suitable choice of the relative strengths of the vortices in the two rings, it is possible to limit the instability to only one special mode of disturbance; this particular configuration becomes, in the limit, the stable Kármán vortex street. J. S. G. T.

2143. Permeability of Porous Alundum Discs for Water and Oils. H. G. Botset. *Rev. Sci. Instruments*, 2. *pp.* 84–95, *Feb.*, 1931.—The rate of flow of filtered and degassed water, which has been in contact for a period with glass, through a porous alundum disc diminishes with time, but the effluent acquires the property of a constant rate of flow. The effect is not observed with slightly acidified water, and is probably due to clogging of the disc by colloidal silica, derived from the glass by hydrolysis. A similar retardation is observed with hydrocarbons such as kerosene and crude oils. The cause is in this case obstruction of the pores of the disc by gummy oxidation products resulting from the simultaneous presence of air and unsaturated hydrocarbons, since if one of these factors be absent the effect does not occur. Permeability measurements with oils should be conducted in an atmosphere of methane. H. F. G.

2144. Influence of Low Temperatures on the Thermal Diffusion Effect. T. L. Ibbs and K. E. Grew. *Phys. Soc., Proc.* 43. *pp.* 142–155; *Disc.*, 155–156, *March* 1, 1931.—Measurements of thermal diffusion on the following gas mixtures at temperatures between 15° C. and −190° C. are described: He—Ne; H_2—Ne; He—A; Ne—A; He—N_2. The experiments confirm and extend the authors' previous work [*ibid.*, 41. pp. 456–475, 1929], showing that there is a general tendency for k_t to decrease at low temperatures. It is found, however, that for the pairs of gases He—Ne and H_2—Ne, with low liquefying points, the change in k_t between 15° C. and −190° C. is small. Chapman's theory is used to deduce approximate values of the laws of repulsive force operating between unlike molecules during collisions. At low temperatures molecules tend to become "softer"

and their behaviour is less like that of rigid elastic spheres. The "hardest" molecules appear to show the smallest variation in k_t. The influence of helium in this respect, on the value of k_t for a mixture, is clearly shown.
AUTHORS.

2145. Theory of Diffusion. B. Hostinský. *Comptes Rendus*, 192. *pp.* 546–548, *March* 2, 1931.—A closed vessel of water contains small solid particles which diffuse through the liquid. A general expression is worked out for the probability that a particle originally at A shall be found after a time *t*, at B, in three cases, *viz.*: (*a*) when the particles exert a pressure on the boundary; (*b*) when the density of distribution of the particles is zero at the boundary; (*c*) when variable currents exist. Methods of solving the equations are indicated.
J. P. A.

2146. Volumes of Liquids as a Function of Pressure and Temperature. P. W. Bridgman. *Am. Acad., Proc.* 66. *pp.* 185–233, *Feb.*, 1931.—The liquid is enclosed in a vessel of thin brass, shaped like a "concertina" aneroid barometer. When this vessel is subjected to hydrostatic pressure this is transmitted to the liquid in the interior, the volume of which diminishes, and the top and bottom of the vessel are brought nearer together. This change in length is measured electrically, and the method has been applied to various liquids, when possible, at 0°, 50° and 95° C., up to a pressure of 12,000 kg./sq. cm., or to the pressure of solidification. Extensive tables are given. The small scale differences in the volumes of various isomers persist at high pressures, and there is no simple connection between the relative densities at atmospheric and high pressures. Thermal expansion drops off by a large factor with increasing pressure, but not as much as the compressibility. The "pressure coefficient" $(\partial p/\partial \tau)_v$ is not a function of the volume only, as has often been supposed; and suggestions are made as to the theoretical significance of this.
H. N. A.

2147. Study of Gaseous Currents by Interference. R. Tremblot. *Comptes Rendus*, 192. *pp.* 480–482, *Feb.* 23, 1931.—A Michelson interferometer with a spark discharge from zinc electrodes is employed, and compressed air expands through a wedge-shaped tube with glass walls placed in the path of one of the beams of light. With changes of density the fringes are displaced. From a measurement of the optical path the density can be determined, and, using the St. Venant's formula, the distribution of speed in the fluid is found. The curve of densities along the axis of the wedge shows a point of inflection, and only where the air speed exceeds that of sound does the density curve resemble Stodola's pressure curve.
R. S. R.

2148. Source of Mechanical Vibration for Experimental Purposes. F. Aughtie. *Phil. Mag.* 11. *pp.* 517–522, *Feb.*, 1931. *Supplement.*—Following a brief *résumé* of early attempts to vibrate a loaded beam in a vertical plane, which were unsuccessful, due either to bad wave form or the presence of excessive horizontal movement, a description is given of the final satisfactory method, which gave a controllable amplitude up to 0·002 inch at frequencies from 8 to 35 cycles/sec. with negligible horizontal movement and good wave form. The necessary force for vibrating the beam was obtained from resonant vibrations of an auxiliary mass-spring system tuned to the working frequency. The oscillations were maintained by a small crank and electric motor, and an important feature was the use

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of solid friction to give a true flat-topped resonance curve, thus permitting small changes of motor speed without variation of amplitude. The equivalent electrical circuit is given of the mechanical filter system used, and records are reproduced of wave forms obtained with different methods.

AUTHOR.

2149. Torsional Oscillations in a Body Bounded by a Surface of Revolution. A. Lokchine. *Comptes Rendus*, 192. *pp*. 542–543, *March* 2, 1931.—The differential equation of motion for torsional displacements in a body is modified to suit the case of a body with a surface of revolution whose axis is the axis of torsion and where displacements are simple periodic functions of the time. The equation is solved for the cases of a sphere, a cone and a paraboloid of revolution. J. P. A.

2150. Tensile Strength of Quartz Fibres. O. Reinkober. *Phys. Zeits*. 32. *pp*. 243–250, *March* 15, 1931.—The tensile strengths of a large number of quartz fibres varying in diameter from 1 to 100 μ, and of various lengths, are measured. The maximum strengths Z are related to the diameters d by the equation $(Z - b)\,d = a$, where b and a are constants; and when Z is measured in kg. sq. mm, and d in μ, a and b have the values 2700 and 60 for newly-made fibres; 1750 and 15 for aged fibres. The presence of the constant a appears to be due to a strong surface film, whose origin is discussed in the paper. J. P. A.

2151. Stresses in a Radially-Spoked Wire Wheel under Loads Applied to the Rim. A. J. S. Pippard and W. E. Francis. *Phil. Mag*. 11. *pp*. 233–285, *Feb*., 1931.—By the methods of strain energy analysis a complete solution of the problem of stress distribution in a radially-spoked, radially-loaded wire wheel has been obtained. This solution, however, when the number of spokes exceeds six, is not by itself of great practical value, since the degree of accuracy required in arithmetical work renders it very long and tedious in use. Sufficient experimental work has been done, however, to justify the use of approximate formulæ based on a mathematical analysis of the case of a wheel having an infinite number of spokes. These approximations hold good for the 24-spoke wheel, and will increase in accuracy as the number of spokes increases. For all wheels falling within the range of normal designs for this class of wheel, expressions are derived for when the load is at a spoke, and when midway between spokes, and also for the maximum tension in a spoke. H. H. Ho.

2152. Bending of an Unclamped Horizontal Rectangular Plate under a Static Load. H. Schmidt. *Zeits. f. Physik*, 68. 5–6. *pp*. 423–432, *March* 24, 1931.—Treats the bending of the plate, which is of uniform thickness, under the action of a static load, uniformly distributed over a rectangular portion of the plate, the sides of which are parallel to the edges. The integration processes previously made use of by the author in other cases are employed. Special cases are: uniform load distributed over the whole plate; loading along a line of any length, parallel to one of the edges of the plate; loading at any point in the plate. There would be no difficulty in applying the method to other distributions of load. [See also Abstract 338 (1931).] H. N. A.

2153. New System of Units. E. Pistolesi. *Pont. Accad. Sci., N. Lincei, Atti*, 84. *pp*. 25–29, *Dec*. 21, 1930.—Pleads for the adoption of the metre as unit of length and the kilogramme as the unit of mass. Proposes the term *vis* for the unit of force. E. E. F. d'A.

2154. Motion of a Body of Variable Mass. D. Graffi. *Accad. Lincei, Atti*, 12. *pp.* 575–578, *Dec.* 7, 1930.—Determines the limits within which the formula found by Levi-Civita [see Abstract 3347 (1930)] is applicable. It is when the density of kinetic energy divided by the density of material is negligible with respect to the square of the velocity of the planet. E. E. F. d'A.

2155. Reduction of Dynamics to Geometry. T. Lewis. *Phil. Mag.* 11. *pp.* 753–760, *March*, 1931.—It is shown that a holonomous dynamical system, with *n* degrees of freedom, moving in a conservative field of force, may be treated as a free system with $(n + 1)$ degrees of freedom, by the introduction of an ignorable coordinate. The path then becomes a geodesic in the $(n + 1)$ configurations-space, the line element of which is given. It is shown how the transition to wave mechanics may be made. G. C. McV

2156. Systems and Volume-Laws of Polyhedra. H. z. Strassen. *Zeits. f. Krist.* 76. *pp.* 335–358, *Feb.*, 1931.—A vector symbolic method is applied, which leads to a systematic treatment of crystal forms. The most general position of the fundamental axes is exhibited by the regular polyhedra, of which the upper limiting case is the sphere. All essential quantities are shown to be comprised within a volume law (for holohedra), which can be represented graphically, based upon the gnomonic projection. F. I. G. R.

2157. Translations with Artificial Crystals. O. Mügge. *Zeits. f. Krist.* 76. *pp.* 359–369, *Feb.*, 1931.—Not suitable for abstraction. The crystals considered are those of hexagonal silver iodide, borneol, pinolglycol, 2:4-dichloroacetanilide, p-xylidene dichloride, pinocamphonoxime, the oxime $C_{10}H_{16}O_2 : NOH$, 2:4:6-tribromotoluene, isobenzil, inactive sobrerol, propionylmenthylamine A, and methylarsenic acid. T. H. P.

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2158. Crystallographic Investigations on Salts of Chlorous Acid. G. R. Levi and A. Scherillo. *Zeits. f. Krist.* 76. *pp.* 431–452, *Feb.*, 1931. *In Italian.*—The results of crystal measurements and X-ray examination are given for the crystals of a number of inorganic salts of chlorous acid. T. H. P.

2159. Strength of "Wetted" Salt Crystals. A. Smekal. *Phys. Zeits.* 32. *pp.* 187–192, *Feb.* 15, 1931. *Paper read before the Deut. Phys. Gesellsch., Dresden, Jan.*, 1931.—The author considers the following points: (1) Static theory of increase of strength by "wetting" experiments. (2) Influence of solution medium in the interior of the crystal. (3) Earlier "wetting" experiments. (4) Increase of strength and breakdown by tearing. (5) "Wetting" experiments. (6) Influence of constitution. (7) Influence of direction of stretching. From the evidence thus deduced it is considered impossible to attain the true lattice strength in Joffe's sense for rock-salt. F. I. G. R.

2160. Influence of Heat Processes on the Building Up of Ultramicroscopic Nuclei in Salt Crystals. R. Matthäi. *Zeits. f. Physik*, 68. 1–2. *pp.* 85–96, *March* 11, 1931.—Counting ultramicroscopic nuclei in transparent crystals gives a very delicate method of following changes which, by their order of magnitude, are not amenable to chemistry. In natural and artificial rock-salt the number of ultramicrons appears to increase with temperature up to about 400° C. and then remain constant. Above 400° C. the number continuously lessens and just below the melting point the crystal is optically clear. The process is at least partially reversible. It appears that above 400° C. the ultramicroscopic particles dissolve increasingly in the solid NaCl. The absorption of ultra-violet follows a complementary course to the number of ultramicroscopically visible particles and therefore appears to be related to the amount of impurity in solid solution. J. E.

2161. Diffusion of Sodium in Rock-Salt. E. Rexer. *Phys. Zeits.* 32. *pp.* 215–216, *Mar.* 1, 1931. *Paper read before the Deut. Phys. Gesellsch., Dresden, Jan.,* 1931.—Sodium was heated to varying temperatures in a cavity in natural rock-salt crystals of various origins. Untempered crystals showed variously distributed colours, mostly green and brown, characteristic of the origin of the crystal. In tempered crystals the coloration was uniform. It is concluded that it is not a case of pure diffusion, but that the effects are due also to the presence of minute impurities. Ultramicroscopic examination shows the presence of white ultramicrons in untempered crystals which disappear in the tempered crystal. Heated with sodium to such a temperature that the crystal is only partially tempered these ultramicrons appear surrounded by coloured sodium ultramicrons. The uniform coloration of the highly tempered crystal is due to the homogenising effect of tempering on the distribution of the impurities. C. A. S.

2162. Precision Measurement of the Lattice Constants of Cuprous Oxide, Cu_2O. M. C. Neuburger. *Zeits. f. Physik,* 67. 11–12. *pp.* 845–850, *Feb.* 25, 1931.—Working with specially pure material, the author obtains the following data: Edge-length of elementary cube $= 4{\cdot}252 \pm 0{\cdot}002$ Å. Molecular volume $= 38{\cdot}43$ Å.^{3}. Density $= 6{\cdot}14$ (compared with values ranging from 5·75 to 6·09 for artificially-prepared Cu_2O). F. I. G. R.

2163. X-Ray Investigation of Lattice Disturbances at Planes of Slip in Rock-Salt. W. Berg. *Wiss. Veröff. a. d. Siemens-Konzern,* 9. 2. *pp.* 119–143, 1930.—A special X-ray tube was employed, in which the kathode rays fell on a tungsten antikathode, and the X-rays were given off from a surface which was cut away so that, while the kathode rays were almost perpendicular to the surface, the X-rays made a very small angle with it. Viewed from the crystal plate on which the X-rays fell, and were reflected on to a parallel photographic plate, the focal spot of the kathode rays on the antikathode would appear as a narrow rectangular source of X-rays. The angle of reflection was such that only $L\alpha_1$ lines of tungsten were received on the photographic plate. In certain positions of the crystal an " image " of the crystal surface was formed on the plate, having a number of sets of parallel bands or lines of different intensity, which crossed one another at angles of 90° or 45°. It is considered that these are due to disturbances of the lattice along definite lines in the crystal surface, so that the angle at which the X-rays are reflected is slightly different along such a line from that in the neighbouring undisturbed portion of the crystal. These disturbances may also penetrate below the surface of the crystal, and have been found to exist unchanged some mm. below, when the upper portions of the rock salt are removed in a suitable way. They are shown to take place on definite planes of slip. For the theory of the method the original paper should be consulted. H. N. A.

2164. X-Ray Investigations of the Hydrides of Titanium, Zirconium, Vanadium and Tantalum. G. Hägg. *Zeits. f. phys. Chem.* 11. *Abt. B.* 5–6. *pp.* 433–454, *Feb.,* 1931.—System Ti-H: The Ti phase (α) dissolves H up to about 33 atomic % and is hexagonal. (β) is probably homogeneous between 50 and 66·7 atomic % H (face-centred cubic). System Zr-H: Solubility about 5 atomic % H in (α), hexagonal. Next phase (β) at about 20 atomic % H, face-centred cubic. Third phase (γ) at about 33 atomic % H, with hexagonal close packing. Fourth phase (δ) at about 50 atomic % H (face-centred cubic). Last phase, probably for 66·7 atomic % H homogeneous, is face-centred tetragonal (ε). System V-H: Non-homogeneous. System Ta-H: About 12 atomic % H (α) is body-centred cubic. Next phase (β) is hexagonal close-packed. At about 50 atomic % H (γ)is homogeneous, with a face-centred rhombic lattice. The effective radius of the hydrogen at 50 atomic % in the hydride phases is 0·46 Å. (mean value). [See also Abstract 2330 (1930).] F. I. G. R.

2165. Regularities in the Crystal Structure of the Hydrides, Borides, Carbides and Nitrides of the Transitional Elements. G. Hägg. *Zeits. f. phys. Chem.* 12. *Abt. B.* 1–2. *pp.* 33–56, *Feb.*, 1931.—It appears that the phases of H, B, C, N, with transitional metals are metallic, which is not so when other metals are concerned [see Abstract 2330 (1930)]. The author discusses the radii of a number of such transitional elements compared with the radii of H, B, C and N, and shows that, for a value of the quotient r(H, B, C, N)/r(metal) less than 0·59, "simple" crystal structures result, whereas if the figure 0·59 is exceeded "complicated" structures are found. The former are described as "interstitial" compounds, and the existence of a borderline ratio is taken to mean that the metal lattice is only capable of limited extension. "Simple" compounds usually show broad regions of homogeneity; "complicated" compounds do not. The "simple" structures are nearly always those of the pure metal. The validity of the assumed radii is carefully considered in each case. F. I. G. R.

2166. X-Ray Investigations of the System Sulphur-Selenium. Part II. The Space Lattice of Monoclinic Selenium (Modification I). F. Halla, F. X. Bosch and E. Mehl. *Zeits. f. phys. Chem.* 11. *Abt. B.* 5–6. *pp.* 455–463, *Feb.*, 1931.—The axial ratios are, $a:b:c = 1 \cdot 669 : 1 : 1 \cdot 640$, with $\beta = 104° \; 38'$ (from the facial angles). The X-ray results are 1·640 : 1 : 1·629. Dimensions of the unit cell—$a = 14 \cdot 77 \pm 0 \cdot 08$Å.; $b = 8 \cdot 99 \pm 0 \cdot 05$ Å.; $c = 14 \cdot 62$ Å. The space group is C_{2h}^{2}, and a molecular lattice of $(Se)_8$ is indicated. [See also Abstract 717 (1931).] F. I. G. R.

2167. Comparison of Crystal Structures of Addition and Substitution Compounds. E. Hertel and K. Schneider. *Zeits. f. phys. Chem.* 12. *Abt. B.* 1–2. *pp.* 109–114, *Feb.*, 1931.—The two substances examined, aniline picrate ($C_{12}H_{10}O_7N_4$) and 2 : 4 : 6-trinitrodiphenylamine, have the same space-group C_{2h}^{5}, but the former has four molecules in the basis cell, and the latter eight. Two identity-periods are alike and one different. F. I. G. R.

2168. Structure of Solid N_2O_4 at Liquid Air Temperature. L. Vegard. *Zeits. f. Physik,* 68. 3–4. *pp.* 184–203, *March* 20, 1931.—A new apparatus for the X-ray determination of the structure of solidified gases is described. The X-ray tube has a rotatable antikathode and the camera a movable plate-holder. X-ray photographs of solid N_2O_4 at liquid air temperature are taken by the powder method. The position of the observed NO_2 lines can be explained by a cubical elementary cell, with a side length of 7·77 Å., which contains 12 molecules with the formula NO_2. The density of solid NO_2 is directly determined and provides the value $\rho = 1 \cdot 942$. All the N-atoms have equal values, hence an arrangement according to the formula N_2O_4 is impossible. The only possible space-lattice is T^5, the molecular elements of NO_2 are linear and symmetrical. The complete lattice consists of three mutually perpendicular chain systems. The central distance N – O, within the molecular elements, is 1·38 Å. J. E. K.

2169. Optical Properties of Heterogeneous Uniaxial Structures. R. Gibrat. *Comptes Rendus,* 192. *pp.* 804–806, *March* 30 *and pp.* 1094–1096, *May* 4, 1931.—Equations to the extraordinary ray and the wave surface in the parallel plates of which a smectic substance is made up have been deduced by application of Fermat's principle to the ray, and therefrom conclusions of a general character regarding heterogeneous uniaxial structures. In similar fashion an equation to the wave surface in a nematic substance is deduced. An alternative result is obtained by applying Fermat's principle to the normal velocities, *i.e.*, by substituting for Fresnel's ellipsoid the indicatrix. The two methods give different formulæ for the shadow dihedron resulting, in the case of azoxyphenetol, in alternative values of 60° and 86° respectively. C. A. S.

2170. Electronic Energy Levels of the Elements, with Special Reference to their Connection with the Sizes and States of Atoms in Metallic Crystals. W. Hume-Rothery. *Phil. Mag.* 11. *pp.* 649–678, *March,* 1931.—The law of sub-groups put forward in an earlier paper [see Abstract 356 (1931)] is shown to apply to the rare gases since the interatomic distance d is given by the expression $d/n = aZ^{-x}$ where Z is the atomic number, n the principal quantum number of the outermost shell of electrons of the atomic core, and a and x are constants. In this paper it is shown that, for the elements at the beginning of the first, second, third and fourth periods, while the interatomic distance varies as Z^{-x} where x is an integer, the energy levels of the x_1 electrons of the outermost group of electrons of the atomic core or ion vary as Z^{2x}. This empirical relation has been used to discuss the interatomic distances of crystals of the transitional elements of the long periods. A method is further suggested for determining the electronic states of the atoms in a crystal. It is concluded that in crystals the transition process begins at Group VI, whereas in the case of free atoms it begins at Group III. F. J. W.

2171. Allotropic Transformation of Calcium. E. Rinck. *Comptes Rendus,* 192. *pp.* 421–423, *Feb.* 16, 1931.—Cooling and resistance curves for metallic calcium show discontinuities near 450°, indicating two forms of calcium: Caα stable below, and Caβ stable above 450°. Attempts to obtain Caβ at the ordinary temperature by sudden cooling failed, but there were distinct indications of a considerable contraction occurring at the passage from Caβ to Caα. C. A. S.

2172. Direct Measurement of Molecular Velocities. I. F. Zartman. *Phys. Rev.* 37. *pp.* 383–391, *Feb.* 15, 1931.—A method is described for the direct measurement of the velocities of neutral molecules. The molecules condense on a glass plate fastened to a cylinder which rotates at a high speed, 241 r.p.s. The molecules having velocities from 168 m./sec. to 673 m./sec. were spread over a band 3 cm. wide. A stream of bismuth molecules is studied and the vapour found to be composed of 40 % Bi and 60 % Bi_2 at a temperature of 851° C. AUTHOR.

2173. Interchange of Translational, Rotational and Vibrational Energy in Molecular Collisions. C. Zener. *Phys. Rev.* 37. *pp.* 556–569, *March* 1, 1931.—The change in internal energy of molecules upon collisions has been analysed. Formulæ for the effective cross-section of inelastic collisions have been obtained as functions of known properties of the molecules, subject to certain conditions. These conditions are: the atoms which come into contact during collision must belong to the first row of the periodic table; the vibrational quantum numbers which suffer a change must be small. Vibrational quantum numbers have a marked reluctance to change during collisions at room temperature. The probability that a N_2 molecule in its first excited vibrational state transfers its energy to He in a head-on collision is $0 \cdot 0^7 6$. The probability that another N_2 molecule absorbs this energy is $0 \cdot 0^4 4$. A lack of resonance of 0·01 volt can decrease the effective cross-section by a factor of 0·02. Rotational quantum numbers change readily except in unusual cases.
AUTHOR.

2174. Quantum Mechanics of Electrons in Crystal Lattices. R. de L. Kronig and W. G. Penney. *Roy. Soc., Proc.* 130. *pp.* 499–513, *Feb.* 3, 1931.—The wave equation representing the motion of an electron in a periodic field of potential can be integrated when the potential takes the form of a series of equidistant rectangular barriers. In the one-dimensional problem for a given limiting case, the spectrum of permissible energy values consists of continuous regions separated by finite intervals. The electrons may have at the same time the characteristic properties of free and of bound electrons. An investigation of the reflection of electrons by a crystal represented by the field of potential described leads to results in qualitative agreement with the experimental facts. G. E. A.

2175. Coupled Oscillators. W. Kossel. *Phys. Zeits.* 32. *pp.* 172–180, *Feb.* 15, 1931.—In view of the importance of resonance phenomena in modern quantum mechanics, it is desirable to give proper discussions of the classical cases of coupled oscillations, both mechanical and electrical. In the exposition here given, certain features overlooked in the usual presentations are brought out. J. H. A.

2176. Macroscopic Oscillators having Frequencies which are One-Valued Energy Functions. C. H. Johansson. *Ann. d. Physik*, 8. 2. *pp.* 129–134, *Feb.* 4, 1931.—If a water jet flowing out normally is suddenly retarded at a point where the surface is still smooth and cylindrical there arises above the point of disturbance a wave-like series of widenings and constrictions which gradually passes over into the undisturbed portion of the jet. This wave configuration is stable if the conditions remain unchanged, and the distance between the fixed positions of maxima and minima of the cross-section of the jet can easily be measured with the microscope. If ν is the frequency of the pulsations of velocity corresponding to the variations of cross-section $\nu = A \cdot E^{3/2}$, where E is the kinetic energy of the water jet at the point of disturbance and A is constant for a definite jet. Considering this equation $\nu = F(E)$ there may be here a macroscopic model so that the conceptions of modern theoretical physics can be worked out with the classical theory. In a continuously flowing water jet without the introduction of a special oscillator element there is met with a periodic acceleration and retardation of the water particles of which the frequency is a one-valued energy function. Similarly it may hold as a general fact that a material particle retarded by collision produces a wave which is definitely determined by the incident energy. In the process of excitation of electromagnetic elementary radiation, where $\nu = 1/h \cdot E$, similar circumstances of collision are conceivable. Thus it may be assumed, first, that the electrons are stable only in certain positions answering to discrete energy values of the atom, and, second, that the electron at the transition to a new position of equilibrium is there retarded as by collision. The characteristics of the collision wave could be calculated according to the classical theory. It is possible to assume that the universality of the h constant and the ideas connected therewith of a " quantisation of energy " are no primary characteristic of energy, but a result of the uniform structure of discontinuous matter. J. J. S.

2177. Method of Obtaining Approximate Solutions of Eigenvalue Problems with Applications to Vibration Problems. W. Meyer zur Capellen. *Ann. d. Physik*, 8. 3. *pp.* 297–352, *Feb.* 19, 1931.—A method is given of solving eigenvalue problems that differ only slightly from others that admit of elementary solution. The method is applied to several practical problems that occur in the theory of vibrations. Solutions are obtained by very short calculations in some cases. It is shown experimentally and graphically that the degree of accuracy obtained is sufficient for the purpose in view. The examples deal with (1) the longitudinal vibrations of a rod of variable cross-section; (2) the vertical vibrations of a long cable suspended from two fixed points; (3) the transverse vibrations of a freely suspended cable; (4) the flexural vibrations of a rod of variable cross-section. H. L. B.

2178. Analogy between the Equations of the Quantum Theory and Maxwell's Equations. M. Fahmy. *Phys. Soc., Proc.* 43. *pp.* 124–126, *March* 1, 1931.—It is known that there is a close analogy, exhibited by the use of five-dimensional tensor notation, between the electromagnetic equations in free space and the first- and second-order equations of the quantum theory. In the present paper an analogy is traced between two tensors, one of which is related to the magnetic and electric moments of a doublet while the other represents the electric and magnetic field-strengths. AUTHOR.

2179. Nuclear Statistics. P. Ehrenfest and J. R. Oppenheimer. *Phys. Rev.* 37. *pp.* 333–338, *Feb.* 15, 1931.—From Pauli's exclusion principle we derive the rule for the symmetry of the wave functions in the coordinates of the centre of gravity of two similar stable clusters of electrons and protons, and justify the assumption that the clusters satisfy the Einstein-Bose or Fermi-Dirac statistics according to whether the number of particles in each cluster is even or odd. The rule is shown to become invalid only when the interaction between the clusters is large enough to disturb their internal motion. AUTHORS.

2180. Extension of Wave Statistics. K. C. Kar and M. Ghosh. *Zeits. f. Physik*, 67. 9–10. *pp.* 699–701, *Feb.* 14, 1931.—In a previous paper [see Abstract 359 (1931)] generalised wave statistics which establish the existence of two sets of waves originated by the electron have been established. One of these sets of waves, *viz.*, the electronic, is now identified with waves travelling in the medium with the velocity of sound, and the identification is shown to afford very satisfactory agreement between calculated and experimental values of the ratio of the specific heat, γ, in the case of 12 gases. The authors consider that γ influences the eigenvalues of the energy levels in molecular spectra.

J. S. G. T.

2181. Equations of Electronic Theory and Dirac's Wave Equation. N. R. Sen. *Zeits. f. Physik,* 68. 3–4. *pp.* 267–273, *March* 20, 1931.—The law of conservation of momentum, as applied to a finite closed region of space, is derived from Dirac's wave equation, and a physical interpretation is obtained for the wave-mechanical mean of a dynamical quantity over a surface. A suitable wave-mechanical Lagrange function is found from which the equations of motion and the energy equation may be derived in the usual way. H. L. B.

2182. Uncertainty Relations of the Quantum Theory. A. E. Ruark. *Zeits. f. Physik,* 68. 3–4. *pp.* 274–277, *March* 20, 1931.—It was shown by Wataghin [see Abstract 738 (1931)] that the uncertainties attaching to space- and time-measurements in the case of a particle of mass m_0 are limited by the relationships: $\Delta q \gtrsim h/m_0c$ and $\Delta t \gtrsim h/m_0c^2$. The present author points out that although the method involved is new and exhibits interesting features, he had himself published these results two years previously. In the present paper the author discusses their physical basis in detail, and briefly considers their connection with the uncertainty relations of Bohr and Heisenberg. The limits of accuracy with which the momentum variables can be determined are also discussed.

H. L. B.

2183. Separability of the Differential Equation of Wave Mechanics. K. F. Herzfeld. *Zeits. f. Physik,* 68. 5–6. *pp.* 325–330, *March* 24, 1931.—According to Robertson (*Math. Ann.* 1928, 98, 749) the solution of a mechanical problem along the lines of classical dynamics can always be derived by separation of the variables, if this is possible in the wave-mechanics discussion of the problem. In the discussion employing classical dynamics the coordinates defining the separation are completely defined geometrically by the complete series of orbital envelopes; the corresponding series of node-surfaces define the separation in the wave-mechanics discussion of the problem. An important case, previously discussed by Liouville and by Staeckel (*Math. Ann.* 1893, 42, 537), is referred to, and it is shown that in all cases of two-dimensional mechanics in which the separation can be effected along classical lines, the separation can likewise be effected when wave-mechanics principles are employed. J. S. G. T.

2184. Resonance Method for Determining G. J. Zahradníček. *Phys. Zeits.* 31. *pp.* 149–150, *Feb.* 1, 1931.—The paper points out an algebraical error in the early part of the analysis given by Kunz in setting out his proposed method [see Abstract 371 (1931)]. The alterations in the various resulting equations are traced out. J. H. A.

2185. Determination of "g" by Means of the Free Swinging Pendulum. C. H. Swick. *Nat. Research Council, Bull. No.* 78. *pp.* 151–166, *Feb.,* 1931.—The author mentions briefly the absolute determination of gravity by Kater's and Repsold's pendulums. For the relative determination of gravity two forms of apparatus are described, (1) Mendenhal or Coast and Geodetic Survey, and (2) v. Sterneck. The former is simpler in design and easier to adjust and use, and it can give an accuracy of 1 × 10^{-3} cm./sec.^{2}. The pendulum carries a plane instead of a knife edge to prevent wear and consequent decrease in length. An interferometer is used to find the movements of the knife edge. The various sources of error are described. The latter form possesses the advantage of a quick change from one pendulum to another. It has also been adapted for use at sea, being swung in a submerged submarine. A combination of simultaneous oscillations of two pendulums in the same receiver swinging in nearly opposite phases in the same plane is used to eliminate motion of the ship. The method is reliable and the accuracy is 1 in 2 × 10^5. R. S. R.

2186. Gravity Measurements with the Eötvös Torsion Balance. D. C. Barton. *Nat. Research Council, Bull. No.* 78. *pp.* 167–190, *Feb.*, 1931.—The paper contains first a description of the principle of the torsion balance and the theory of its action. Introduction of a heavy mass in the soil or subsoil distorts the level surfaces and causes a rotation of the beam. From the value of the torque, the curvature and gradient can be obtained. These will be affected by irregularities in mass near the station, but by suitable choice of site and the use of several adjoining stations these effects can be avoided. The order of deviation introduced by planetary motion, continental masses, large and small mountain masses and geological differences, surface inequalities in the soil and subsoil and topographical irregularities are set out, and from these the larger or smaller anomalies can be studied. A close parallelism exists between the irregularities of mass disturbance and geological structure.

R. S. R.

2187. Gravitational Field Produced by Light. R. C. Tolman, P. Ehrenfest and B. Podolsky. *Phys. Rev.* 37. *pp.* 602–615, *March* 1, 1931.—Expressions are obtained, in accordance with Einstein's approximate solution of the equations of general relativity valid in weak fields, for the effect of steady pencils and passing pulses of light on the line element in their neighbourhood. The gravitational fields implied by these line elements are then studied by examining the velocity of test rays of light and the acceleration of test particles in such fields. Test rays moving parallel to the pencil or pulse do so with uniform unit velocity the same as that in the pencil or pulse itself. Test rays moving in other directions experience a gravitational action. A test particle placed at a point equally distant from the two ends of a pencil experiences no acceleration parallel to the pencil, but is accelerated towards the pencil by *twice* the amount which would be calculated from a simple application of the Newtonian theory. The result is satisfactory from the point of view of the conservation of momentum. A test particle placed at a point equally distant from the two ends of the track of a pulse experiences no net integrated acceleration parallel to the track, but experiences a net acceleration towards the track which is satisfactory from the point of view of the conservation of momentum. AUTHORS.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

2188. Dynamics of Rain. F. Ahlborn. *Phys. Zeits.* 32. *pp.* 139–147, *Feb.* 1, 1931.—The author deals first with numerical relations for the maximum size and maximum rate of fall of drops, and the changes in the shape of the drop because of air resistance. The shapes of liquid drops are shown by the fall of drops of chloroform or CS_2 in salt solutions or the ascent of air bubbles in water. The calculated rates of fall agree with observations after making assumptions regarding the flattening of the drops and the consequent increased horizontal diameter. By the action of the air pressure on the drop a vortex is created, while a similar effect occurs with heated ascending air. The field round a rain drop is similar to that round an ellipsoid. Collision and growth of drops are examined. The changes occurring when a drop strikes a water surface are discussed, the broken drops which are thrown up and the vortex moving into the liquid being illustrated by diagrams. Finally, the general circulation of the air in a rain shower, the large-scale vortex formed and the pulsating and turbulent air motion are dealt with. R. S. R.

2189. Absorption of Radiation and Proportion of Ozone in the Lower Atmosphere. C. Fabry and H. Buisson. *Comptes Rendus,* 192. *pp.* 457–460, *Feb.* 23, 1931.—The absence of short wave-lengths in the light received from stars may be due to the presence of small quantities of ozone in the atmosphere. It should then be possible to express the "optical density" D of the atmosphere through a layer 1 km. thick (defined as $D = \log_{10} I_0/I$, where I_0 and I are incident and transmitted energies respectively), after correction for molecular diffusion, in the form $D = \alpha x + d$, where x is the thickness of ozone, in cm. at atmospheric pressure, present in 1 km. of air, α is the absorption coefficient for ozone, and d represents the "optical density" due to other causes. d will be constant if, for instance, this decrease in intensity is caused by particles which are large compared with the wave-length. The expression is found to be quite accurate over the range 3300 Å. to 2650 Å., and the value obtained for x is 0·0022 cm., corresponding to 3·6 mg. per 100 kg. of air at 15°, which is of the order found by chemical analysis. Below 2600 Å. the absorption increases very rapidly, and is attributed to oxygen. C. B. A.

2190. Geophysical Prospecting. E. Lancaster-Jones. *Journ. Sci. Instruments,* 8. 2. *pp.* 34–44, *Feb.,* 1931.

Four groups of instruments are considered. (1) Gravitational: the Eötvös torsion balance is taken as typical and its principle of action explained in giving the location, depth and size of a "disturbing" mass. (2) Magnetic: Schmidt's portable vertical variometer is considered as typical, while an experimental form of horizontal variometer is also described. (3) Seismic: the principle of the vertical vibrometer is explained and how, by reception of waves at a distance through the air and through two earth strata at different depths, the depth of the separating surface is obtained. (4) Electrical: potential and resistivity methods are used for conducting media and electromagnetic for

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badly conducting regions. Diagrams and plates illustrate several forms of apparatus. R. S. R.

2191. Tidal Theory. A. T. Doodson. *Nat. Research Council, Bull. No.* 78. *pp.* 19–39, *Feb.*, 1931.—The author first outlines the general forces acting to produce tidal motion and the use of the potential of such forces. The motion of a particle of water under these and other forces leads to the dynamical equations of motion and the equation of continuity. These are simplified by assumptions approximating to actual conditions. The application of these equations to tidal motion in specified basins is very difficult with the earth rotating as an actuality, but the cases of rectangular, circular, semicircular and narrow basins are discussed and also the conditions for the polar ocean and zonal oceans. Finally, the production of co-tidal lines in the North Sea by Harris, Sterneck and the Tidal Institute, and also co-range lines by the last-named, are examined. R. S. R.

2192. Tidal Computations and Predictions. P. Schureman. *Nat. Research Council, Bull.* 78. *pp.* 40–49, *Feb.*, 1931.—In the non-harmonic treatment of tides high and low waters form the principal basis, while hourly heights are used to study sea-level changes in establishing tide-planes and long-period changes in the earth's crust. The results sought include mean high- and low-water heights, the range of tide and lunitidal intervals and variations due to changes in phase, parallax and declination of the sun and moon. In the harmonic analysis of tides the several component simple harmonic motions are attributed to some periodic cause mainly astronomical, and then used to classify tides and predict for the future. The uses of these two methods or combinations of them in tidal analysis and prediction are outlined. Finally, corrections for tides in shallow waters are discussed. R. S. R.

2193. Mean Sea Level. H. A. Marmer. *Nat. Research Council, Bull. No.* 78. *pp.* 50–67, *Feb.*, 1931.—Variations in mean sea level are produced by tides, meteorological conditions such as pressure, wind and weather, and the amount of fresh water discharge. Curves of daily monthly and annual sea levels for various coastal districts of the U.S.A. show large local and regional differences, but the annual changes are much the same over a large area. Doubt exists regarding periods $>$ 1 year owing to insufficient data. The larger variations are due to pressure and wind changes. Earth movements which change the volume of ocean basins or ocean water also occur. Finally, to determine mean sea level 19 years' observations are required, but a shorter series can be used by comparison with a neighbouring standard station, and the possible errors for observations extending over a year, month or day are given. R. S. R.

2194. Earth Tides. W. D. Lambert. *Nat. Research Council, Bull. No.* 78. *pp.* 68–80, *Feb.*, 1931.—Consideration is given to primary and secondary earth tides, the former being due to the sun and moon, and the latter due to the varying tidal load of water. Calculations show that the primary tide is a matter of a few inches. A review is given of calculations made to determine the earth tide. In the earliest method, historically, long-period tides were used, but corrections are needed and objections arise. In later methods the changes produced in the direction of the vertical are used, and referred to the direction of the earth's axis on the ground on which the instrument rests. The differences in

Schweydar's and Michelson and Gale's results are considered, and the objections raised to the former on account of the assumptions regarding rigidity at different depths. Finally, the results of the analysis by the International Latitude Service are examined. R. S. R.

2195. Tidal Friction. W. D. Lambert. *Nat. Research Council, Bull. No.* 78. *pp.* 81–99, *Feb.,* 1931.—Friction occurs between particles of water and between moving water and the earth, and it originates in the rotational energy, axial and orbital, of the earth-moon system. From the principle of conservation of energy and other fundamental principles of mechanics, the rate of slowing down of the axial rotation of the earth and the orbital revolution of the moon is obtained. It is shown that tidal friction in the shallow seas accounts for that part of the secular variation of the moon not provided for by the ordinary lunar theory because (1) the best estimates of the dissipation of energy in shallow seas can just account for the apparent secular acceleration of the moon, and (2) the assumption of any considerable dissipation of energy in the body of the earth would contradict the observed behaviour of Chandlerian nutation in the variation of latitude. Also the mean rate of dissipation of energy as estimated from co-tidal maps of the globe is shown to be in good agreement with the value obtained from tidal currents in shallow seas. Finally, the results of tidal friction in the geological past are considered, and their bearing on the disruption of the moon from the earth. R. S. R.

2196. Isostasy. W. Bowie. *Nat. Research Council, Bull. No.* 78. *pp.* 103–115, *Feb.,* 1931.—After stating the principle of isostasy that prisms of the earth's crust having vertical planes have the same mass and exert the same pressure on the sub-crustal material, it is shown that former investigations required prisms 50 to 100 miles square. The views of Airy and Pratt regarding the depth and density of the crustal material are outlined. The acceptance of isostasy theory results from investigations on the deflection of the vertical and on gravity. Recent calculations for the depth of the crustal material give 96 km., but assumptions are necessary. Finally, the residuals or anomalies of gravity and their causes and values in different regions are considered R. S. R.

2197. Shape and Size of the Earth. W. D. Lambert. *Nat. Research Council, Bull. No.* 78. *pp.* 123–150, *Feb.,* 1931.—A summary is given of historical evidence regarding the shape and size of the earth from the time of Pythagoras, the commencement of triangulation, the establishment of the spheroidal shape of the earth, the measurement of the degree of arc, and the adoption of the international ellipsoid of reference. In the determination of the figure of the earth from gravity observations Clairaut's formula for the flattening of the earth is used and two methods given by Stokes to compute the form of the level surface, (1) involving spherical harmonics, and (2) a transformation of these, are set out and illustrated by an example. The lunar methods used to obtain the flattening of the earth are discussed, these depending upon parallax of the moon or lunar perturbations. The methods by which the results so obtained may be reconciled with those of the international ellipsoid are finally examined. R. S. R.

2198. Potsdam Eclipse Expedition to Sumatra (1929). Coronal and Prominence Spectra. W. Grotrian. *Zeits. f. Astrophysik,* 2. 2. *pp.* 106–132, *March* 2, 1931.—Two glass spectrographs and one quartz one were used, the slits in all three being set tangential to the east limb of the sun, and it happened that this arrangement caught a large prominence as well as the corona. The experimental set-up is described in full detail. Wave-lengths of the coronal lines are given, but the main object was the study of intensities. The conclusion that relative intensities of different lines vary at different eclipses is confirmed. A large number of prominence-lines is listed; almost all occur with comparable relative intensities in the chromosphere above 1000 km., and almost all chromosphere lines of this level are included. The continuous spectrum of the corona does not show Fraunhofer lines, except for a few terrestrial ones; it is to be further studied in a later communication. R. d'E. A.

2199. Solar and Lunar Spectra Taken in Little America, Antarctica. M. P. Hanson and E. O. Hulburt. *Phys. Rev.* 37. *pp.* 477–480, *March* 1, 1931.—Solar spectra were taken with a small quartz spectrograph at noon on Nov. 13, 1929, and Jan. 25, 1930, in Little America, Antarctica, by M. P. Hanson of the Byrd Antarctic Expedition. The ultra-violet limit of these spectra was at about 304 $\mu\mu$, which was the same as the ultra-violet limit of noon solar spectra taken at Washington, D.C., in Dec. and Jan. Assuming that the ultra-violet limit of the solar spectra was due to ozone in the upper atmosphere, and that the amount of ozone in Washington was the same as that measured by Dobson, Harrison and Lawrence at Oxford, England, it came out that the effective thickness of the ozone at N.T.P. above Little America was about 0·28 cm. on Nov. 13, 1929 and Jan. 25, 1930. The ultra-violet limit of lunar spectra taken at Little America on April 24, 1929, two days after the Antarctic winter night set in, and on July 18, 1929, thirty-five days before the night ended, was at about 305 $\mu\mu$. AUTHORS.

2200. Accurate and Simple Formula for the Identification of Small Planets. B. Jekhowsky. *Comptes Rendus,* 192. *pp.* 404–406, *Feb.* 16, 1931.—Using the expression previously stated [see Abstract 2414 (1929)] for the variation of right ascension and declination of a small planet as a function of the variations of $d\rho$ (geocentric distance), dr (heliocentric distance) and $d\nu$ (true anomaly), an equation is derived in the form $j = d\delta/dx = 15'(z' - \bar{x}' \sin \delta)/\bar{y}'$, where $\bar{x}'$ and $\bar{y}'$ are the projections of x and y on the axes selected. From a single observation of the planet while allowing for variations of $d\rho$ and dr one can calculate for each instant the exact value of j, which is so important to identify small planets. R. S. R.

2201. Variation of Latitude. W. D. Lambert, F. Schlesinger and E. W. Brown. *Nat. Research Council, Bull. No.* 78. *pp.* 245–277, *Feb.*, 1931.—In an historical summary reference is made to Euler's mathematical analysis and the Euler nutation giving an earth period of 10 months. Kustner's observations on the variation of latitude led to Chandler's investigation and a period of 428 days, the former investigation having taken no account of the elasticity of the earth itself and the mobility of the ocean. The three different poles involved in the theory of the variation of latitude are next considered. The long-period observations used to find the variation of latitude are dealt with. The curves of the observed motion of the pole given by Wanach for 1890–1900, 1900–1912 and 1912–1918 are given. An analysis of the annual and semi-annual components is set out, and the polar motion so derived agrees reasonably well with observation. The Chandlerian rotation is then combined with the annual to give the path of the undisturbed pole of figure. This rotation is variable in phase and amplitude, while seasonal meteorological conditions are also variable. Irregularities in the rotation of the earth are due to changes in the earth's moment of inertia about its axis of rotation, and thus shrinking and swelling of the earth result, which King ascribes to magnetostriction. The secular motion of the pole is not supported adequately or directly by astronomical evidence, and cannot explain the large climatic changes in geological time. The Kimura term and its causes are examined. Finally, the geophysical and astronomical significance of the variation of latitude is discussed. R. S. R.

2202. Variation of Latitude. T. Matukuma. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 55–60, *Feb.*, 1931. *In French.*—The author shows that, according to the theory of relativity, the curvature of space produced by the presence of the sun should produce fluctuations in the latitude of a place on the earth calculated from observations on stars. The numerical values of the fluctuations are, however, rather below the limits of accurate observation. G. C. McV.

2203. New Expression for the Orientation of the Great Circle in Asteroid Research. B. Jekhowsky. *Comptes Rendus,* 192. *pp.* 277–278, *Feb.* 2, 1931.—Proceeding from the formula [see Abstract 2415 (1929)] for the variation of the declination of an asteroid corresponding to a displacement of one minute in right ascension, an expression is obtained in the form $j = 15' \cos \delta \sin \delta' \tan (\nu - \alpha')$ where α' and δ' are angular coordinates of the new system parallel to the position of rest. R. S. R.

2204. Transmutation of Elements in Stars. A. H. Wilson. *Roy. Astron. Soc., M.N.* 91. *pp.* 283–290, *Jan.*, 1931.—The problem of radiative capture of a proton by a nucleus is discussed mathematically. The analysis shows that at stellar temperatures of the order estimated by Eddington, *viz.*, 4×10^7 degrees, the chance of capture is negligible except in the case of the very lightest nuclei. At temperatures of the order 10^{11} degrees, estimated by Milne, captures of the type referred to will predominate even over resonance captures. At temperatures of the order 10^9 degrees, resonance captures predominate. The author concludes that some modification of the theory of stellar interiors, such as that proposed by Milne, is necessary [see also Abstract 3939 (1930)]. J. S. G. T.

2205. Stability of Outer Layers of a Star. B. Thüring. *Zeits. f. Astrophysik,* 2. 1. *pp.* 70–77, *Jan.* 15, 1931.—The stability is discussed by considering virtual displacements of whole layers of the material of the star in an outward direction. If the ratio of specific heats in such a layer of the star falls below a certain critical value, as a result of ionisation, the layer must become unstable. This instability can be compensated for by supposing the star to depart from the perfect gas state. G. C. McV.

2206. Method of Least Squares for the Calculation of the Orbits of Double Stars. C. Volet. *Comptes Rendus,* 192. *pp.* 482–484, *Feb.* 23, 1931.—In employing in the usual way the method of least squares for a second approximation to the elements of the star's trajectory various objections arise and are enumerated. The difficulties can be avoided by using the rectangular coordinates of the satellites and treating them as directly observed. The elements of the orbit are then found in such a way that the sum of the squares of the errors between the observed and calculated positions is a minimum. The method is set out and the equations are established. R. S. R.

2207. Density of White Dwarf Stars. S. Chandrasekhar. *Phil. Mag.* 11. *pp.* 592–596, *Feb.*, 1931. *Supplement.*—The density of the white dwarf stars is reconsidered from the point of view of the theory of the polytropic gas spheres, and gives for the *mean density* of a white dwarf (under ideal conditions) the formula $\rho = 2\cdot162 \times 10^6 \times (M/\odot)^2$ The above formula is derived on considerations which are a much nearer approximation to the conditions *actually existent* in a white dwarf than the previous calculations of Stoner [see Abstract 3088 (1930)] based on uniform density distribution in the star and which gave for the limiting density the formula $\rho = 3\cdot977 \times 10^6 \times (M/\odot)^2$. AUTHOR.

2208. Stellar Hydrogen Lines and the Stark Effect. C. T. Elvey and O. Struve. *Astrophys. J.* 72. *pp.* 277–300, *Dec.*, 1930.—The wings of the hydrogen lines in early-type stars, photographed with rather short exposures, are found to be often considerably more extensive than had been supposed; in the less luminous stars the wings of successive lines probably overlap all the way from short wave-lengths up to Hδ. Supergiants have narrower lines, and the total absorption in them is also much less at a given spectral type. If stars having the same total absorption in the H lines are compared, irrespective of spectral type, the contours still differ, the supergiants again showing the narrower lines. In supergiants the Unsöld formula fits the observed contours well, and there is presumably no Stark effect; that the Stark effect is responsible in stars in which the lines are wider is shown by a comparison of helium lines of the principal and diffuse series; the latter are wide and hazy even in cases where rotation must be small, since the former are sharp. The widening effect of the chaotic electric fields due to neighbouring ions is calculated on certain simplifying assumptions, account being taken of the changes in absorption coefficient and density with height, and contours are obtained which agree better with observation than Unsöld's formula (no Stark effect); there seems, however, to be some additional cause increasing the total absorption in these cases. The large number of H lines visible even in dwarfs is due to the hydrogen at the top of the reversing layer, which is always practically free from electric fields. Since the Stark effect increases with serial number, and the total absorption increases with the Stark effect, high series members may in any case be more prominent than in the laboratory. In the fainter stars, where the lines overlap, the relation between temperature and colour-index may be quite abnormal. R. d'E. A.

2209. Varying Intensity of Lines in Spectrum of α^2 CVn. A. Markov. *Astrophys. J.* 72. *pp.* 301–310, *Dec.*, 1930.—Previous work by several observers is compared with the author's observations, and lines are listed which show changes in intensity. The changes are all periodic, with a period of about 5·5 days, but the lines fall into two main classes; in Class I the lines are strongest when the star itself is faintest, and in Class II when it is brightest. There are about 35 lines in Class I and about 50 in Class II, a few lines being doubtful; there are also a few lines which seem to be strongest at both maximum and minimum, but these are believed to be blends. There are indications of secular or long-period changes in both the intensities and the period. R. d'E. A.

2210. Magnitudes of Southern Comparison Stars for Eros. F. H. Seares, B. W. Sitterly and Mary C. Joyner. *Mount Wilson Observat. Contrib., No.* 415. *Astrophys. J.* 72. *pp.* 311–342, *Dec.,* 1930.—Photographic and photovisual magnitudes of 300 comparison stars for Eros (mag. 7–10) and 74 brighter additional stars (mag. 5–7) are obtained from measurements of a series of overlapping plates of the region involved; most of the stars appear on four different plates. The average probable errors for a single plate are less than 0·1 magnitude in all cases. There are some systematic differences from the results of other observatories, and these are discussed in full. Average colour-indexes for the various spectral classes are given, and these also show some discordances when compared with other sources. The material is critically examined. R. d'E. A.

2211. Spectral Changes of 17 Leporis. O. Struve. *Astrophys. J.* 72. *pp.* 343–345, *Dec.,* 1930.—This star is a spectroscopic binary showing in addition marked changes in its spectrum. In 1912, and again in the autumn of 1930, it showed very weak lines, whereas in 1925, 1928 and January, 1929, there were many strong ones; in December, 1930, it had nearly returned to this state. The lines most affected are, in order, those of ScII, TiII, FeI (a few), and FeII; MgII and H are not affected in intensity. Several strong lines of TiII and FeII, one of ScII, and perhaps one of MgII are double when the lines are weak; the doubling is not, however, the principal cause of the weakening. The MgII line (4481) shows a small positive radial velocity, while the other lines show considerable negative ones, at all times. The hydrogen lines are peculiar. The star is not known to vary in brightness, and no orbit has been obtained. R. d'E. A.

2212. Spectra of Novae. W. Grotrian. *Zeits. f. Astrophysik,* 2. 1. *pp.* 78–82, Jan. 15, 1931.—Discussion of observational material to show that the yellow-green line λ5577 of the Aurora Borealis, as well as the red OI lines λ6300 and λ6364, can be separately observed in the spectra of Novae. G. C. McV.

2213. Raffety Bands in Comets. N. T. Bobrovnikoff. *Astrophys. J.* 73. *pp.* 61–76, *March,* 1931.—Fourteen nuclear bands of unknown origin in the spectra of comets situated between λ3987 and λ4109 have been investigated in detail. Data compiled from determinations of the wave-lengths of these bands in twelve comets with slit-spectrographs have been used for this purpose. The wave-lengths correspond to those obtained in the laboratory by C. W. Raffety [see Abstract 229 (1917)] for the spectrum presumably of the CH molecule. The agreement is not complete. Neither the $^1\Pi - {}^1\Pi$ carbon system nor the cyanogen tail bands can be identified with the cometary bands. The variation in brightness of the bands, depending on the heliocentric distance of the comet, shows that they form at least two systems. The intensity-curves fall between that of the CH band λ4314 and the CN band λ3883. It is shown that the edges of eleven bands can be represented tolerably well by the formula $\nu = 24{,}335 + 71{\cdot}0n - 0{\cdot}1n^2$. Assuming the final state of the molecule that of the violet and red cyanogen systems the formula becomes $\nu = 24{,}328 + (2126{\cdot}6v' - 13{\cdot}85v'^2) - (2055{\cdot}6v'' - 12{\cdot}75v''^2)$. This formula gives a good representation of six more bands in the region where there are no other nuclear bands within several hundred Ångströms. It is suggested that the CN molecule may be the carrier of these bands. The remaining unidentified cometary bands are probably due to the CH molecule. Celestial sources having carbon and cyanogen spectra have been compared with comets. The bands in question appear to be typical for comets. AUTHOR.

2214. Photometric and Spectrographic Orbits of T. T. Aurigæ. A. H. Joy and B. W. Sitterly. *Mt. Wilson Observat., Contrib. No.* 419. *Astrophys. J.* 73. *pp.* 77–93, *March*, 1931.—Calculations based on unpublished photometric work from 1910 to 1915, and on spectroscopic work (both spectra visible) from 1917 to 1930. The light-curve is of the β Lyræ type (rounded maxima). All the usual data are obtained, including approximate absolute magnitudes and parallax (based on an assumed surface temperature); the stars are fairly close together, markedly elliptical, apparently not darkened at the limb, but perhaps showing some reflection-effect, and the orbit is probably not quite circular. The absolute magnitudes obtained fit the M–L relation fairly well, and the stars (B3 with very wide lines) are described as " normal in every way." R. d'E. A.

2215. Origin of Bright Lines in Spectra of Stars of Class B. O. Struve. *Astrophys. J.* 73. *pp.* 94–103, *March*, 1931.—The observational material is summarised in detail; in particular, where the emission lines are double, the absorption lines are wide and indicate rapid rotation, and where the emission lines are single the rotation seems to be small. It is suggested that the rotation is really rapid in all these stars, those with narrow lines being viewed axially, and that this rotation causes matter to be ejected at the equator and form a nebulous ring capable of having an emission spectrum. The contours to be expected for the emission lines are shown to agree qualitatively with observation, the separation of the " doublets " in any one star is approximately proportional to the wave-length, and the relative frequency of occurrence of the various calculated axial inclinations is consistent with a random distribution of orientations. R. d'E. A.

2216. Stars of Classes B5–A0 with Lines of MnIII. W. W. Morgan. *Astrophys. J.* 73. *pp.* 104–117, *March*, 1931.—Lines attributed to ionised manganese in the spectrum of α Andromedæ have now been found in thirteen other stars of spectral classes B5–A0; probably the stage of ionisation is the second (MnIII). The spectroscopic behaviour of the element, as inferred from such energy-relationships as are known, seems to be quite normal, and the absolute magnitudes of the stars in which it occurs are apparently normal also. The stars are, however, somewhat uncommon; in a total of 202 stars which might reasonably be expected to show the lines, only 18 % of those in class B9 do so, and only 11 % of those in class B8. R. d'E. A.

2217. Titanium Comparison Spectrum as a Photometric Scale. P. C. Keenan. *Astrophys. J.* 73. *pp.* 118–123, *March*, 1931.—In order to provide photometric calibration for early stellar spectrograms lacking sensitometer exposures the relative intensities of eighteen lines in the Ti comparison spectrum were determined. Measurements of total absorption of stellar hydrogen lines by means of this scale agree within 15 % with those obtained by the use of the ordinary sensitometer curves. AUTHOR.

2218. Maintenance of Pulsations in Cepheids. B. P. Gerasimovič. *Zeits. f. Astrophysik,* 2. 2. *pp.* 85–94, *March* 2, 1931.—Observationally it is found that for Cepheids of period $<$ 10 days the number of stars possessing a given pulsation-amplitude, plotted as a function of the amplitude, shows a maximum. This occurs at fairly small amplitudes, but is probably not due merely to observational selection. In a mathematical discussion it is claimed that, on the assumption that Cepheids are being produced at a steady rate, with various initial amplitudes, such a maximum cannot occur if the amplitudes never increase after creation, but could occur if a subatomic source at first maintained (and increased) the amplitudes, as would presumably follow from Eddington's theory. The view that the Cepheids are still being created at a constant rate, and that their amplitudes at creation are spread over a finite range, is regarded as an important addition to Eddington's theory. R. d'E. A.

2219. Influence of Instrumental Sensitivity-Curves on the Determination of Stellar Temperatures from Colour-Indices. M. Kienle. *Zeits. f. Astrophysik,* 2. 2. *pp.* 95–105, *March* 2, 1931.—The theory of colour-indices and of Brill's "isophotal wave-lengths" is discussed. A comparison of the brightness indicated by two different measuring-systems permits the calculation of the temperature of the source if the sensitivity-curves of both systems are known and if the source be assumed black over the range of both; a third system, with a different sensitivity-range, is necessary if the extent of departure from black-body distribution is to be studied. It is desirable that sensitivity-ranges should be fairly small, and the "red magnitudes" obtained with panchromatic plates and colour-filters may thus become important; the combined sensitivity of instrument + filter + plate should, however, be investigated. Sensitivity-curves for the eye (rod-vision and cone-vision), and for various usual combinations of plates and instruments, are given, and it is shown that the differences are often more serious than is supposed. Photographic plates can also exhibit an analogue to the Purkinje effect. R. d'E. A.

2220. Mean Light-Curves of Long-Period Variable Stars. Part II. T. Cassiopeiæ. A. A. Nijland. *K. Akad. Amsterdam, Proc.* 34. 2. *pp.* 217–223, 1931.—This star has been continuously observed between the years 1905 and 1929. The observed curves, showing 25 maxima, and the mean curve deduced from these, are shown on two diagrams. The period is 449 days, the minimum $11^{\mathrm{m}}.63$ and maximum $7^{\mathrm{m}}.67$. A strongly marked hump occurs regularly on the ascending branch, as if the star were obscured in some way, and but for this would have a symmetrical curve and a maximum two magnitudes brighter. M. A. E.

2221. Larger Magellanic Cloud. Parts I and II. A Cosmographic Survey. H. Shapley. *Harvard College Obs., Bull.* 881. *pp.* 1–9, *Feb.* 1, 1931.—The author gives a photograph of the Greater Cloud and a contour map. This last is outlined, roughly, for four types of regions: (i) the axis, an elongated, densely crowded patch reaching from 5^{h} to $5^{\mathrm{h}}\,40^{\mathrm{m}}$; (ii) several cluster areas; (iii) semi-clustered areas, the larger lying on the Cloud's western border; (iv) open regions with a few globular clusters, but relatively poor in supergiant stars. The Cloud's distance is 26·2 kiloparsecs with the present zero point of the period-luminosity curve [see following Abstract]; its extreme diameter is 3200 parsecs. The distance between the larger and smaller clouds is about 10 kiloparsecs, in which no classical Cepheids, class 0 spectra or gaseous nebulæ have been found. Near 30 Doradus (the brightest gaseous nebula in the Large Cloud) the star frequency falls off; in some regions there is dark nebulosity. Twelve selected regions in the Large Cloud have been counted, yielding a total of 5700 stars of different magnitudes, extending from the brightest magnitude up to 17·7, but in practice all fainter than 17·1 are left out. The author concludes that it is possible for such selected areas to form a census of the high luminosity stars, the present counts extending from absolute magnitude − 6 to zero. There is 10 times the star density near the crowded axis than near the open geometrical centre. There are 26,710 stars brighter than absolute magnitude − 2, and 214,000 brighter than absolute magnitude zero. He finds a general luminosity curve, but this is insignificant because of local deviations. There is a concentration of cluster stars between absolute magnitudes − 4·5 and − 1·5. A. S. D. M.

2222. Proper Motions and Luminosities of Galactic Cepheids. B. P. Gerasimovič. *Astron. J.* 41. *pp.* 17–24, *Feb.* 16, 1931.—The author traces criticisms of Shapley's period-luminosity law from Curtis (1921) to Schilt (1928), and examines the residue of doubt as to the shape and zero point of Shapley's curve, since the principles of (even restricted) uniformity in the laws governing the universe have been seriously invalidated by Schilt's criticisms. He forms from new and improved sources a table of Galactic Cepheid proper motions (finding a possible systematic error in $\mu\alpha$ for the fainter stars), and subdivides all classical Cepheid periods into A (1 — 9·99 days) and B (10 — 45 days) with 33 and 11 stars respectively. For the A group, the apex deviates widely from standard values, but radial velocities do not substantiate this, and he finds that improved motions tend to decrease Cepheid angular motions. For solar speed and mean peculiar velocity, he obtains for A and B groups, $\bar{v} = 11\cdot8 \pm 1\cdot0$ and $\bar{r}A = +4\cdot5 \pm 1\cdot4$, which latter is of the right sign and a relatively small probable error. Two independent methods give Π_m as $0''\cdot0026$ and $0''\cdot0027$ respectively. The mean median absolute photographic magnitudes are for A $-0^m\cdot6$ and for B $-1^m\cdot6$, with a final correction of $+0^m\cdot1$. The final zero-point correction to Shapley's period luminosity curve is $0^m\cdot8$, indicating a close agreement between Shapley's curve based on Magellanic variables (when shifted down by $0^m\cdot8$) and that based on proper motions and radial velocities of galactic Cepheids, rendering it difficult to doubt the general correctness of Shapley's curves so successfully applied to anagalactic nebulæ by Hubble.

A. S. D. M.

2223. Hydrogen Emission Lines in Nebulæ. H. H. Plaskett. *Observatory,* 54. *pp.* 49–56, *Feb.,* 1931.—A reply to Carroll [see Abstract 3095 (1930)]. The author discusses the validity of Carroll's treatment of the mechanism of emission and claims that it cannot lead to a unique distinction between various possible mechanisms. The variation of Balmer decrement in the nebulæ is shown to exist. Reasons are given for believing that the Balmer lines are due predominantly to ionisation and recombination. G. C. McV.

LIGHT.

2224. Variations of Colour of Cobaltous Chloride Solutions. E. Toporescu. *Comptes Rendus,* 192. *pp.* 280–282, *Feb.* 2, 1931.—The temperature at which the colour of 0·717 % solutions of cobaltous chloride in different alcohols changes from blue to pink falls regularly from 3° C. in methyl alcohol to − 65° C. in n-amyl alcohol, *i.e.,* as the dielectric constant of the solvent diminishes. Further, the change from pink to blue in methyl alcohol solution is favoured by addition of substances which lower the dielectric constant of the alcohol and retarded by addition of substances which exert the reverse influence. The colour change is therefore intimately related to the dielectric constant of the solution, and its occurrence is ascribed not to variations of the ionisation, solvation, or structure of the chloride, but to a change of the state of aggregation of the solvent. H. F. G.

2225. Colour Vision. R. A. Houstoun. *Phil. Mag.* 11. *pp.* 552–569, *Feb.,* 1931. *Supplement.*—A discussion of the conditions which a theory of colour vision must satisfy, the author's opinion being in favour of the presence of two nuclear and two reticular layers in the retina, and against the view that there are three photochemical substances or three nerve systems for which anatomically there is no evidence. It is concluded that the light and colour processes are quite separate, one taking place in the layer of the rods and cones, and the other in the reticular layers; if the light has a certain intensity the same fibres are stimulated, no matter what is the colour, but the proportions existing in the different states depend on the colour. It is shown that in colour-mixing problems the above scheme leads to the same result as the Young-Helmholtz scheme. The application of the theory to the explanation of after-images, simultaneous contrast, and the growth and decay of the sensation is considered. A note on the relative visibility of the different colours of the spectrum concludes a very comprehensive paper. H. H. Ho.

2226. Dispersion and Refractive Index of Nitrogen Measured as Functions of Pressure by Displacement Interferometry. C. E. Bennett. *Phys. Rev.* 37. *pp.* 263–275, *Feb.* 1, 1931.—A method of measuring refractive index and dispersion of a gas by displacement interferometry is described and discussed, and justified experimentally. It is used to determine the refractive indices of nitrogen at high pressures at 0° C. and 30° C. for three wave-lengths. The values at N.T.P. agree well with those of previous observers. Over a range of seven atmospheres, the Lorentz-Lorenz relation is obeyed, and the dispersion is a linear function of pressure. The refractive index at infinite wave-length deduced by means of a Cauchy formula gives a value of the dielectric constant agreeing very closely with the experimental value. C. B. A.

2227. Effect of Elliptical Polarisation upon Energy Transmission. R.V. Baud. *J.O.S.A.* 21. *pp.* 119–122, *Feb.,* 1931.—This paper contains the equation for the energy transmission in a polarised light equipment that is composed of lenses, two crossed polarising prisms, two crossed mica plates in 45° position with respect to the prisms, and a light source that produces " white " light. The present study of the energy transmission is primarily a continuation of previous photoelastic researches [see Abstract 3972 (1930)]. However, it is believed that the equation given will be of interest and practical use not only for workers in the field of optical stress analysis, but also for investigators working with the same equipment along other lines. AUTHOR.

2228. Double Refraction in Safrol. Pauthenier and Bart. *Comptes Rendus*, 192. *pp.* 352–353, *Feb.* 9, 1931.—The authors find no appreciable remanent double refraction either in a constant or in an alternating field with commercial or with carefully purified safrol for temperatures between 15° and 25° C. Kerr's constant for pure safrol is $K = 0 \cdot 82 \cdot 10^{-7}$ C.G.S. units, for the green mercury line 5460 Å. The classical method, using a h.t. a.c. field, described by Cotton and Mouton, was employed, and some notes are given as to its application. H. N. A.

2229. Residual Double Refraction. F. C. Harris. *Phil. Mag.* 11. *pp.* 745–748, *March*, 1931.—A definite residual retardation is produced in certain glasses at atmospheric temperature by applying uniform pressure for a long time. In any given time the magnitude of the residual double refraction is greater for glasses containing large amounts of PbO than for those containing small amounts. In no case was there any observed increase in the double refraction during the time the load was left on. A. D.

2230. Temperature Relationship of Electrical Birefringence in Organic Liquids. A. Kürten. *Phys. Zeits.* 32. *pp.* 251–252, *March* 15, 1931.—An adaptation of the Schmidt and des Coudres method for the relative determination of the Kerr constants. They used two condensers, one with fixed and the other with variable plate distance. The material to be examined is placed between the fixed plates and the circuit balanced by adjustment of the variable condenser. The same principle is now used for the determination of the variations in the value of the Kerr constant with temperature. Experimental details are given and results quoted in tables and graphs for CS_2 and other liquids. S. G. B.

2231. Magneto-Optical Dispersion of Organic Liquids. Part II. Methyl Propionate, Ethyl Propionate, and Ethyl Formate. I. Jenkins and E. J. Evans. *Phil. Mag.* 11. *pp.* 377–396, *Feb.*, 1931.—In continuation of work described in the previous paper [see Abstract 1167 (1931)] the magneto-optical rotations and refractive indices of methyl and ethyl propionates and of ethyl formate for various wave-lengths are now measured. The respective values of the characteristic frequencies controlling the magnetic rotations are found to be about $0 \cdot 1\,\mu$, and increase with increasing molecular weight of the liquid. They also satisfy simple Drude expressions for the refractive dispersions. The calculated values of e/m are about 1×10^7. C. B. A.

2232. Magnetic Rotatory Power of Halogen Derivatives of Saturated Hydrocarbons in the Vapour State. R. de Mallemann and P. Gabiano. *Comptes Rendus*, 192. *pp.* 278–280, *Feb.* 2, 1931.—The magnetic rotation and density of the vapour, and the magnetic rotation, density and refractive index of the liquid, have been measured for a number of alkyl halides at a wave-length of $578\,\mu\mu$. The results, together with those previously reported [see Abstract 1517 (1931)], yield for the atomic rotatory power of hydrogen, carbon, chlorine, bromine and iodine the values 5·5, 10, 33, 66 and 143 respectively. The ratio of the ionic to the atomic rotatory powers of the halogens is approximately constant. The atomic rotation of hydrogen in organic compounds is only slightly lower than that of the gas in the free state. H. F. G.

2233. Variation of Specific Magnetic Rotatory Power during Passage from the Liquid to the Gaseous State. R. de Mallemann and P. Gabiano. *Comptes Rendus*, 192. *pp*. 487–489, *Feb*. 23, 1931.—Measurements with a number of compounds show that the change of the magnetic rotatory power which occurs on change of state may be calculated approximately by means of the factor $(n^2 + 2)/3$, which, despite certain theoretical objections, thus represents the mean effect of the inter-molecular field. H. F. G.

2234. Scattering of Radiation. O. Halpern. *Zeits. f. Physik*, 67. 7–8. *pp*. 523–530, *Feb*. 6, 1931.—Mainly mathematical. On the basis of both the classical and the quantum theory it is shown that during the scattering of monochromatic spectral lines at a single resonator light is produced which possesses the characteristic frequency of the irradiated system and an intensity which is of the same order of magnitude as that of the radiation scattered without change of frequency. Experimental investigation of the effect in the visible spectrum is difficult, but should be practicable in the X-ray region. H. F. G.

2235. Comparison of Diffraction Effects in Reflecting and Refracting Telescopes. L. Roy. *Comptes Rendus*, 192. *pp*. 461–464, *Feb*. 23, 1931.—The effect of the obstruction due to the small mirror of a reflector on the diffraction patterns obtained is discussed for four types of viewed object met with in astronomical measurements. The reflector is inferior to the refractor of equal aperture for distinguishing dark points or lines on a bright field, or for appreciation of weak contrast between contiguous fields. Its advantages in viewing bright points or lines on a dark background can be obtained with a refractor by stopping out the centre of the objective. In addition, a given reflector is not equivalent to a refractor of definite aperture, as this aperture depends on the size and nature of the object under observation. C. B. A.

2236. Twenty-First Annual Exhibition of the Physical and Optical Societies. *Journ. Sci. Instruments*, 8. *pp*. 69–75, *Feb*., 1931.—Notes on Exhibits: "Optical Instruments," by **W. B. Coutts**; "Microscopes," by **D. J. Scourfield.**

2237. Automatic Recording Camera for Discontinuous Operation. C. G. Sumner. *Journ. Sci. Instruments*, 8. *pp*. 104–109, *March*, 1931.—A method is described for operating automatically a recording camera by which separate exposures at arbitrary time intervals may be made, the exposed sensitive paper being wound on after each exposure without being driven continuously. AUTHOR.

2238. Stroboscopic Effects in Rotating Sector Disc. B. W. Bartlett. *Rev. Sci. Instruments*, 2. *pp*. 96–110, *Feb*., 1931.—The author gives a theoretical investigation of the stationary patterns which are seen when a rotating disc, painted with alternate black and white sectors, is illuminated by a lamp of rhythmically varying intensity. The formulæ derived by means of Fourier analysis are shown to agree qualitatively with the results of observation on actual discs. A quantitative check would require some means for measuring fairly accurately the intensities of the patterns seen. J. W. T. W.

2239. The "Flashometer." N. H. Brachman and C. W. Kendall. *Rev. Sci. Instruments,* 2. *pp.* 111–117, *Feb.,* 1931.—The "flashometer," as used by the U.S. Air Corps for flash powder observations, gives a record which shows the duration of the flash and gives a rough idea of the intensity time variation. The authors have improved on this by adapting to the instrument a neutral optical wedge. Fairly precise comparisons can now be made of the peak intensities of various powders; and also the time-lag can be determined of any mechanism by means of which a camera shutter is tripped automatically by the flashlight powder explosion. The mathematical questions involved are discussed. A. D.

2240. Reflecting and Transmitting Substances and New Apparatus for their Investigation. R. G. Weigel and W. Ott. *Zeits. f. Instrumentenk.* 51. *pp.* 1–19, *Jan., and pp.* 61–77, *Feb.,* 1931.—The authors review first the wide applications of reflection and transmission of light such as room lighting, lamps, photometry and in many branches of industry. Regular, diffuse or mixed reflection and transmission and selective absorption are next considered in a general way, and the polarisation phenomena following on reflection at different angles. An historical review of experiments in these subjects ranging over two centuries is given. The conditions are then laid down which should be satisfied by an instrument used to investigate these properties of the reflection, transmission and absorption of solids, powders or liquids. These include measurements in diffuse light, measurement of scattered light and spectral and polarisation phenomena in the reflected and transmitted light. Particulars are given of the new instrument and the performance and evaluation of measurements with it are described. R. S. R.

2241. Reflecting Screens for Relief Picture Projection. H. E. Ives. *J.O.S.A.* 21. *pp.* 109–118, *Feb.,* 1931.—If a series of pictures, taken from juxtaposed points of view, are projected from a battery of projectors on to a reflecting screen, the projected picture will exhibit relief, provided the screen has certain properties. These properties are (1) that of reflecting the light beams directly back toward the projectors, with no lateral spread, and (2) that of introducing a vertical spread or diffusion. Two types of reflecting screens having these properties are described. One consists of vertical rods, of front and rear curvatures such that the image of the projecting lens formed by the front surface is accurately in focus on the rear surface, which is coated with diffusing material. The second type consists of vertical strips of mirror, standing in pairs at 90° to each other and alternately plane and horizontally ribbed. [See also Abstract 2469 (1929).] AUTHOR.

2242. New Use of Apparatus for Measuring the Angle between Optical Axes. C. Gaudefroy. *Comptes Rendus,* 192. *pp.* 290–291, *Feb.* 2, 1931.—It is shown how the apparatus previously described by the author [see Abstract 3000 (1928)] can be used to determine the angle between optical axes not only when the plane containing the axes is parallel to the crystal surface but also in any case, no matter how the plate is cut. The method involves the use of a liquid of the same refractive index as the crystal. The paper should be consulted for details. J. E.

2243. Optical Coincidence Gauge. I. C. Gardner and F. A. Case. *Bureau of Standards, J. of Research*, 6. *pp.* 229–237, *Feb.*, 1931.—A new type of optical instrument is described which enables one to make measurements in a direction normal to the surface viewed. Furthermore, the method of operation is sufficiently simple to permit its use for routine industrial measurements. The instrument is similar to a military range-finder except that the two telescopes forming the optical system of the range-finder are replaced by two microscopes. In the instrument which has been constructed at the National Bureau of Standards, the magnification is approximately 85 and, under favourable conditions, the probable error of a single reading is approximately ± 0·001 mm. (± 0·00004 in.). As the settings are made without mechanical contact the instrument is particularly well adapted for measurements where all danger of deformation of the object should be avoided. It can also be used for making a measurement which terminates at an optical image, and this possibility has been realised in a second optical coincidence gauge which was built for the purpose of adjusting the sound-reproducing mechanism of a motion-picture projector. AUTHORS.

2244. Rotatory Compensators of Combined Plates of Doubly Refracting Crystals. A. Ehringhaus. *Zeits. f. Krist.* 76. *pp.* 315–321, *Feb.*, 1931.—A new compensator plate is described which consists of two plates cut parallel to the optic axis of a uniaxial crystal and placed together in the " subtraction " position. A formula is deduced for the dependence of path difference on the inclination of the plate to incident light, and as an example a combination plate made up of two quartz plates each 1 mm. thick is calculated. The calculations are checked by experiment, and the plate gives satisfactory accuracy and utility over a wide spectral range. In conjunction with a function table from which the path difference for the C, D and F lines can be read for a given inclination angle, such a plate forms a simple instrument for the determination of the relative dispersion of double refraction. C. B. A.

2245. Spherical Aberration of Optical Systems. J. Picht. *Zeits. f. Hochfrequenztechn.* 51. *pp.* 77–81, *Feb.*, 1931.—Expressions are developed to obtain the spherical aberration of an optical system in terms of the inclination of the rays of a beam of light to the optic axis of the system. The results are illustrated diagrammatically. R. S. R.

2246. Sources of Illumination for Ultra-Violet Microscopy. B. K. Johnson. *Phys. Soc., Proc.* 43. *pp.* 127–136; *Disc.*, 137, *March* 1, 1931.—The paper describes experiences encountered in an attempt to find means for reducing the exposures hitherto necessary in ultra-violet microscopy. Amongst the subjects dealt with are quantitative measurements of the relative intrinsic brightness of spectrum lines given by various sources of radiation; methods of producing a monochromatic source suitable for this work; the steadiness of the illuminant; the effect on the definition of the image when a triple spectrum line is used as a source; the study of electrical conditions for the production of increased brightness of the spark, such as the effects of change in frequency, secondary potential, capacity and energy input; and the production of a compact and inexpensive electrical unit for use with the ultra-violet microscope. AUTHOR.

2247. Theory of the Microscope. L. C. Martin. *Phys. Soc., Proc.* 43. *pp.* 186–207; *Disc.*, 207–211, *March* 1, 1931.—The paper examines the diffraction effects produced by (*a*) two adjacent apertures, and (*b*) a series of apertures in an opaque screen situated in the focal plane of a lens system, when the illuminating system is projecting the elementary image of a point-source of light into this object plane. The diffraction effects and geometrical resolving power of the grating are shown to be independent of the concentration of the light in the object plane; they depend rather on the number of apertures free to transmit light. The theory is then extended to the case where the illumination of the object is produced by a source of finite area. Both the equivalence and Abbe principles appear in the analysis of the mode of formation of the image in such critical illumination, but subject to the difficulties encountered in integrating for the effects of finite sources of light. Confirmatory experimental work is in hand. AUTHOR.

2248. High-Dispersion Prism Spectrograph. K. Wurm. *Zeits. f. Astrophysik*, **2.** 2. *pp.* 133–150, *March* 2, 1931.—The 3-prism train of the Einstein Institute was found to need a long-focus lens if its full resolving power were to be utilised; a set-up is described which achieves this. The arrangement is the autocollimating one, the light passing through the prisms twice and being focussed, by a 9-m. lens, on a plate directly below the slit. The dispersion is about 2 Å./mm. in the yellow, and 0·4 Å./mm. at 3800 Å.; the latter figure is comparable with that for the 4th or 5th order of a Rowland 6-m. grating. The theoretical resolving power is 340,000 at 4000 Å., and experiment showed that it is nearly reached in practice. The influence of the absorption, which is considerable, is discussed theoretically, and it is shown that it neither displaces the lines nor makes them unsymmetrical, and reduces their sharpness by only a small amount. Photographs of lines, and photometer curves of them are included. R. d'E. A.

2249. Secondary Reactions in Latent Image Formation. T. S. Price. *Brit. Phot. Research Assoc. Lab., Comm. No.* 77. *Phot. J.* **71.** *pp.* 59–69, *Feb.*, 1931.—In previous papers it has been shown that the sensitivity of a photographic emulsion depends on its pH at the time of coating. Within the limits of pH investigated, the higher the pH the greater is the sensitivity. In this paper the influence of free alkali halide has been investigated. To provide a comparison with the emulsion experiments the velocity of reaction between gelatin and hypochlorite or hypobromite solutions has been measured for values of pH between 5 and 10, the pH during any particular experiment remaining constant. The results with hypobromite solutions were markedly different from those with hypochlorite, free halogen being contained in all solutions below a pH of 9; the concentration of OBr′-ion rises continuously with increase in pH, much as did that of the OCl′-ion, and comparison shows that reaction with gelatin is mainly due to this component of the hypobromite solution. In the case of the hypoiodites, the equilibrium is much more on the side of free iodine than it is on the side of free bromine in the case of hypobromites. The paper contains a mass of interesting detail which cannot be adequately abstracted. H. H. Ho.

2250. Hydrolysis during the Washing of the System Gelatin-Silver Nitrate. H. H. Schmidt and F. Pretschner. *Zeits. f. wiss. Phot.* **28.** *pp.* 328–332, *Feb.*, 1931.—A number of analytical experiments have established hydrolysis when a silver nitrate-gelatin emulsion is

washed, and it is concluded that silver nitrate reacts with gelatin to form an intermediate organic silver compound with consequent easy removal of the nitrate ion by water. Similar work by Lumière and Seyewetz with gelatin and alum is cited wherein analogous washing phenomena are obtained. The work indicates the ready hydrolysis of silver salts by gelatin.
H. H. Ho.

2251. Solarisation. Part IV. H. Arens. *Zeits. f. wiss. Phot.* 28. *pp.* 341–348, *Feb.*, 1931.—The work on the dependence of solarisation on the method of preparation of the emulsion, begun in Part II [see Abstract 3994 (1930)], is continued. It is found that an emulsion which is prepared shortly after the separation of the peptised silver compound, is either not solarised at all or only very slightly affected. When the AgBr precipitate is allowed to stand for some time the property of solarisation increases in the emulsion prepared from this material. The time for this change to take place is the smaller as the content of silver ions decreases. When the silver ions are reduced as far as possible by the addition of KBr, a silver bromide is obtained which solarises strongly after peptisation. F. J. B.

2252. Photonegative Effect with Silver Bromide. E. A. Kirillow. *Zeits. f. wiss. Phot.* 28. *pp.* 367–373, *March*, 1931.—A variety of experiments, including determinations of the conductivity in the dark and at intervals after irradiation, and measurements of the resistance by a method which eliminates the influence of polarisation, demonstrate that of the three most probable causes of the photonegative sensitivity of silver bromide, namely, a true decrease of conductivity, an increase of the polarisation velocity, or a change of contact potential under the influence of light, the first-named is the true cause. H. F. G.

2253. Sensitive Photographic Plates for the Red and Infra-Red. G. Haft and W. Hanle. *Zeits. f. wiss. Phot.* 28. *pp.* 374–376, *March*, 1931.—The sensitivities of a number of commercial types of plates have been compared, especially for the region 6000–8000 Å., with particular regard to their uniformity throughout the visible spectrum. One type is sensitive to nearly 9000 Å., but there are pronounced minima at about 6400 and 5000 Å., whilst another type has a moderately uniform sensitivity up to nearly 8000 Å. H. F. G.

2254. Sensitiveness of Photographic Plates in the Region including Very Soft X-Rays and the Extreme Ultra-Violet. M. Söderman. *Zeits. f. Physik*, 67. 11–12. *pp.* 790–793, *Feb.* 25, 1931.—Spectrograms were taken at the same time on two different plates, placed side by side, and were compared. It was found that Schumann plates were considerably more sensitive than the others experimented with in the region 50 to 500 Å. H. N. A.

2255. Accumulation Effect of Photographic Plates and its Influence on Photographic Photometry. N. Barabascheff and B. Semejkin. *Zeits. f. wiss. Phot.* 28. *pp.* 333–340, *Feb.*, 1931.—The effect on photographic density of the time between exposure and development has been examined for a number of plates, and it is concluded that this factor must be taken into account in the photometry of actinic rays. Plates should be developed within two days in order to avoid systematic errors which may influence the final result. F. S.

2256. Photomicrography with the 365 mμ Mercury-Arc Line. A. P. H. Trivelli and L. V. Foster. *J.O.S.A.* 21. *pp.* 124–131, *Feb.*, 1931.—The advantages of this procedure over Köhler's ultra-violet photomicrographic outfit are given. Chromatic correction is obtained satisfactorily with a glass system, the Hg arc lamp and filters are a simpler outfit and the focussing is greatly simplified. Sandalwood is the most suitable for immersion and the Eastman Speedway plate the fastest for this radiation. The ultra-violet absorption of 37 stains is tabulated. R. S. R.

2257. Photometric Sensibility of the Eye and the Precision of Photometric Observations. E. M. Lowry. *J.O.S.A.* 21. *pp.* 132–136, *Feb.*, 1931.—A series of photometer tests was made for the range 0·6 to 250 millilamberts using the most sensitive part of the retina around the fovea. The photometric sensibility ΔB/B, where ΔB is the least perceptible difference in brightness of the two halves of the field for a field brightness B, is obtained. The curve connecting ΔB/B and B is a minimum at 25–30 ml. in agreement with Halliday's results. At this brightness the average deviation from the mean of a single observation is 0·19 % while the maximum is 0·41 %. R. S. R.

2258. Extension of the Standard Visibility Function to Intervals of 1 Millimicron by Third-Difference Osculatory Interpolation. D. B. Judd. *Bureau of Standards, J. of Research*, 6. *pp.* 465–471, *March*, 1931.—The two empiric representations [see Abstract 824 (1924)] and Walsh (*J.O.S.A. and R.S.I.* 11. pp. 111–112, 1925) of the visibility of radiant energy yield curves which fail to pass exactly through the values at every 10 mμ adopted as standard; hence, they cannot serve as means of obtaining interpolated values. By the method of osculatory interpolation the visibility function is represented as a series of parabolæ of the third degree which join at the specified values so as to have a common first derivative at the junction point. The discontinuities in derivatives of higher order which exist at the junction points are sufficiently small to be of no consequence. AUTHOR.

2259. Photometric Properties of Rough Diffusing Surfaces. J. Dourgnon and P. Waguet. *Comptes Rendus*, 192. *pp.* 406–408, *Feb.* 16, 1931.—Several different samples were employed having different reflecting factors and a hemispherical cavity of 5 mm. diameter was scraped in each. Perfectly uniform illumination and brightness of the plane and hemispherical portions were obtained and measurements of the reflected light made. The factor of correction due to the curvature of the surface can be expressed in the form $\xi = A/(1 - B\rho)$ where A and B are pure geometrical contrasts which can be found empirically and ρ is the reflecting factor of the surface. Agreement to 4 % is obtained between the calculated and measured values. R. S. R.

2260. Photometry of the Neon Glow Light. M. J. Druyvesteyn and N. Warmoltz. *Zeits. f. Physik*, 68. 5–6. *pp.* 378–394, *March* 24, 1931.—The intensity of the light from the glow proved to be proportional to the current, being quite independent of the kathode fall, provided that this was less than 285 volts. It was almost independent of the pressure of the gas. In the direction perpendicular to the kathode it was 15 international candles per ampere. The influence of an addition of argon and of mixture with helium was studied; also the relation between the intensity and the angle between the direction of the emitted light and the surface of the kathode. The results can for the greater part be explained on the assumption that the light from the negative glow is mainly produced by excitation of the neon atoms by comparatively slow electrons, with a velocity of about 25 volts. The theory of the process is discussed in some detail; the effect of the aureole, if any, surrounding the glow being considered. The effect of a small amount of argon is apparently due to its destroying the metastable Ne atoms by collisions of the second kind. These metastable atoms in pure neon produce the aureole. H. N. A.

2261. Application of the Wynn-Williams Bridge Valve Amplifier to Microphotometry and Absorption Problems. H. G. Heil. *Phil. Mag.* 11. *pp.* 736–740, *March,* 1931.—The arrangement is for the most part like that explained in detail by Razek and Mulder, and by Wynn-Williams. The two high resistances, which connect the grids of the two valves of the bridge more or less directly to earth, are of xylol or xylol-alcohol. They should be approximately equal to secure steadiness of the zero reading. All parts of the arrangement must be very well screened from external disturbances. The active plate of the photoelectric cell was connected to the grid of one of the two valves, the other terminal of the cell being connected to the positive pole of a battery, the other pole of which was earthed. The results obtained are compared with those of a Moll recording microphotometer, and are found to be by no means inferior, though the limit of sensitivity was by no means reached, since the galvanometer employed was shunted with a 10-ohm coil, and the amount of light entering the photoelectric cell could have been increased several times.

H. N. A.

2262. Mechanical Equivalent of Light. L. S. Ornstein, E. F. M. van der Held and D. Vermeulen. *K. Akad. Amsterdam, Proc.* 34. 2. *pp.* 212–213, 1931.—Describes a new determination of the mechanical equivalent of light from the candle-power and measured radiation from two gas-filled lamps operating at a colour temperature of 2500° C. The values obtained are 0·00167 and 0·00168 watt per international lumen.

J. W. T. W.

2263. Optical Relations between Alkali Halogen Phosphors and Complex Salt Solutions of Lead and Thallium Halides. H. Fromherz. *Zeits. f. Physik,* 68. 3–4. *pp.* 233–243, *March* 20, 1931.—The close relation between the heavy metal complex ions in solutions and the active centre in luminescent alkali halides which has already been pointed out is seen in the close agreement between the absorption of the complex ions of silver and copper in concentrated alkali halide solutions with the absorption of the alkali halide phosphors containing silver and copper respectively. These facts have now been extended by investigations on halide phosphors and complex solutions containing lead and thallium. The absorption curves in the solution and in the crystal are again remarkably similar. J. E.

2264. Ultra-Violet Absorption Spectrum of Acetylene. G. B. Kistiakowsky. *Phys. Rev.* 37. *pp.* 276–278, *Feb.* 1, 1931.—It is shown that the ultra-violet absorption bands reported previously [see Abstract 1147 (1913)] do not belong to acetylene but to some impurity. In pure acetylene bands are observed only below 2400 Å. These bands are arranged into three progressions and their interpretation is proposed using information from the work on the infra-red absorption spectrum of acetylene. AUTHOR.

2265. Absorption of the Carbonyl Chromophore in Short-Wave Ultra-Violet Regions. H. Ley and B. Arends. *Zeits. f. phys. Chem.* 12. *Abt. B.* 1–2. *pp.* 132–138, *Feb.*, 1931.—The absorption band of acetone in hexane solution in the ultra-violet shows a maximum at 187 mμ, this being displaced to a shorter wave-length in aqueous solution. Such displacement is in the same direction as for short-wave ultra-violet rays. The results are compared with those obtained for compounds containing two chromophores, namely, carbonyl and ethylene groupings. [See Abstract 172 (1930).] T. H. P.

2266. Absorption Spectrum of Dissolved Mercury. H. Reichardt and K. F. Bonhoeffer. *Zeits. f. Physik*, 67. 11–12. *pp.* 780–789, *Feb.* 25, 1931.—Metallic mercury was found to dissolve in hot water, methyl alcohol and hexane to such an extent that characteristic absorption phenomena were produced, which were studied spectroscopically. A quartz tube 70 mm. long was employed, with plane windows at the ends. This was contained in an iron cylinder, the pressure of the air in which was kept 10 to 15 atmospheres higher than the vapour pressure of the liquid in the tube. The tube was electrically heated. Two absorption bands, near the line 2537 Å., were observed with each of the liquids used, which were due to the dissolved mercury. The distance between the bands diminished in the order, water, methyl alcohol, hexane. They approach one another when the density of the liquid diminishes owing to rise of temperature. The bands are interpreted as being due to the splitting up of the line 2537 Å. in the electrical field of the molecules of the solvent liquid. The solubility of mercury increases in the order, water, methyl alcohol, hexane. A rise in absorption at 2200 Å. in the solution in water is provisionally ascribed to ionisation of dissolved mercury atoms. H. N. A.

2267. Absorption Spectra of Solutions of the Coloured Ions Cu, Cr, Co in Water. Marya Kahanowicz and P. Orecchioni. *Zeits. f. Physik*, 68. 1–2. *pp.* 126–132; *March* 11, 1931.—The curves for the extinction coefficients due to the electrolytes Ni, Cu, Cr and Co have been drawn in the whole visible spectrum, for increasing dilutions. Consideration of the photometric curves confirms the fact that there are three well-defined phases in the absorption, which can be explained as due to a molecular phase, a phase with free ions, and a phase with complex ions. This appears to supply a new proof for the classical theory of progressive dissociation. H. N. A.

2268. Theory of Intermittent Action in the Infra-Red. D. K. Sen and B. Biswas. *Calcutta Math. Soc., Bull.* 22. *pp.* 199–209, *Dec.*, 1930.—The expression obtained by Kar and Biswas [see Abstract 2166 (1930)] is deduced from a different view of intermittent action. F. S.

2269. Vibrational Levels of the ICl Molecule. W. E. Curtis and O. Darbyshire. *Faraday Soc., Trans.* 27. *pp.* 77–87, *Feb.*, 1931.—There is a discrepancy between the results obtained by Gibson and Ramsperger by measuring the effect of temperature on the relative intensities of the vibrational progressions, and those based by Patkowski and Curtis on the isotope effect. The rotation structure is unresolved, so it is not possible to determine absorption coefficients. The authors found by calculation that, under the conditions of their experiment, the progression $v'' = 1$ should be unchanged in intensity by raising the temperature from 15° to 200° C., $v'' = 0$ should decrease by about 50 % and $v'' = 2$ should increase by about 100 % with the same change of temperature. As a matter of fact all the progressions were found to increase; but this seemed to be partly due to continuous absorption imposed on the bands, which also increased with temperature. This probably accounts for Gibson and Ramsperger's result. There was some evidence that, if the continuous absorption could be eliminated, the second progression would remain constant, and could then be identified with $v'' = 1$. This would indicate that the first and longest progression originated in the lowest vibrational state, as concluded by Patkowski and Curtis. H. N. A.

2270. Spark Spectra of Chlorine. K. Murakawa. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers No.* **287.** *pp.* **105–109,** *Feb.* **15, 1931.**—When a larger spark gap and greater exciting current are employed than is necessary to produce the spectrum of singly ionised chlorine [see Abstract **1547 (1931)**], lines due to Cl III appear, together with others due to impurities. The lines have been classified and the wave-numbers and term combinations are tabulated; a strong multiplet at **3991–4104** Å. is interpreted as $3d\,{}^4P - 4p\,{}^4P$. Photography of the spectrum of singly ionised chlorine through an echelon grating indicates that the line at **5217** Å. is double and that the line at **5392** Å. is a singlet. The intensities and term combinations of these lines and of those at **4572, 5221,** and **4569** Å. are tabulated; the intensity ratio of the last two is **7**: **5**, a value which differs considerably from that obtained by other workers. H. F. G.

2271. H.F. Spectrum of Nitrogen in Presence of Mercury. R. Zouckermann. *Comptes Rendus,* **192.** *pp.* **409–411,** *Feb.* **16, 1931.**—Compares by means of a Hilger quartz spectrograph, the spectra of nitrogen when excited by waves of length 10 m. and 570 m. respectively. The spectra consisted chiefly of nitrogen and cyanogen bands. The lines of atomic N were absent. The bands of positive N were always bright, especially at the higher frequency. The negative bands, however, almost disappeared at the higher frequency, whereas some of the mercury lines increased in intensity. E. E. F. d'A.

2272. Discharges and Spectra due to Electronic Impacts in Hydrogen. S. Vencov. *Ann. de Physique,* **15.** *pp.* **131–266,** *Feb.,* **1931.**—Discharges caused by electronic impacts in hydrogen are investigated simultaneously by an electrical and a spectroscopic method for the purpose of correlating critical potentials with the appearance of the different spectra of hydrogen. Special precautions are taken to restrict the formation of atomic hydrogen by secondary processes. The apparatus consists of a valve with two grids and a side tube provided with a quartz window to allow the resulting radiation to be photographed. The following values are obtained for the critical potentials: the resonance potential of the molecule **11·5 ± 0·6** volts, the ionisation potential of the atom **13·6 ± 0·2** volts, the ionisation potential of the molecule with the formation of H_2^+ **16·5 ± 0·6** volts, the dissociation of the molecule together with the ionisation of an atom **29·7 ± 0·6** volts (this is erroneously given as **19·7** volts on p. **261**). Experiment shows that: (1) The atomic spectrum can be observed only with difficulty when the accelerating potential is below **18** volts; its intensity increases up to **30** volts and then slowly tends to a constant value. (2) The band spectrum appears at the ionisation potential of the molecule. The intensities of Richardson's systems of singlets and triplets do not vary in unison as the acceleration potential varies. (3) The continuous atomic spectrum does not appear at all. (4) The continuous molecular spectrum appears simultaneously with the band spectrum and its intensity increases with the accelerating potential.

The variations of intensity have also been examined for (*A*) different electronic currents (gas pressure being kept constant) and (*B*) different gas pressures. In case (*A*) the atomic spectrum becomes more intense, the band spectrum tends to disappear near the glowing filament, the continuous molecular spectrum becomes more intense particularly near the filament. In case (*B*) it is found that below 30 volts the atomic spectrum becomes more intense up to a value of the pressure between 0·1 and 1 mm. Above 30 volts the atomic spectrum and the continuous spectrum slowly increase in intensity up to a constant value, while the band spectrum loses in intensity. An increase in the proportion of ionised particles favours the production of the continuous spectrum and weakens the secondary spectrum. According to the principle of Condon it appears that the critical potential at 29·7 volts must correspond to the transformation $H_2 \rightarrow H + H^+ + e +$ kinetic energy. The origin of the different spectra is discussed in detail and the effect of an admixture of mercury vapour is described. The paper concludes with 110 references to the contributions of other authors. H. L. B.

2273. New Band System of Hydrogen. Z. Bay, W. Finkelnburg and W. Steiner. *Zeits. f. phys. Chem.* 11. *Abt. B.* 5–6. *pp.* 351–362, *Feb.*, 1931.—A strongly condensed discharge (½ mfd. capacity) excites a new band in the yellow and several strong lines throughout the spectrum. Measurements of intensity show the yellow band to be due to the H_2 molecule. The spectrum has been photographed with a 2-m. grating, and among the 140 lines measured several constant differences have been found. It is shown that both band systems have the same initial and final terms. F. S.

2274. New Bands in the Secondary Spectrum of Hydrogen. D. S. Jog. *Phil. Mag.* 11. *pp.* 761–786, *March,* 1931.—It is pointed out that the origin of more than 80 % of lines in this spectrum is still unknown and that work up to now has been based on the accepted selection rules. A departure from this procedure is suggested, and bands are discussed assuming a transition between the B-level of Dieke and the 3^3P-levels of Richardson. F. S.

2275. Relationships between the Continuous and the Many-Lined Spectra of Hydrogen. Part II. Y. Hukumoto. *Tohoku Univ., Sci. Reports,* 20. *pp.* 178–194, *March,* 1931. *In English.*—The present paper contains the results of a spectroscopic examination of the striated discharge in hydrogen. Spectrograms were taken of the light emitted by the various types of strata; the narrow bluish, the wide reddish strata, etc. The electronic energies in the various strata were interpreted from these spectra and the carriers of striation were inferred. In all cases the continuous spectrum is accompanied by the band groups of the triplet system of the hydrogen molecule in greater intensity than the other many-lined spectrum. These facts seem to support the view of Winans and Stueckelberg [see Abstract 1549 (1929)] about the origin of the continuous spectrum of hydrogen molecule. [See also Abstract 1540 (1931).] AUTHOR.

2276. Spectra of Hydrogen and Helium Produced by Condensed Discharge. H. Nagaoka and T. Futagami. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 54–56, *Feb.*, 1931. *In English.*—By a method similar to that of

Hulburt [see Abstract 4009 (1930)], the effect of a condensed discharge on the spectra of hydrogen and helium is investigated. The Balmer lines are found to become diffuse, the individual effects varying from line to line. A similar but much smaller effect is observed in helium. Hulburt's conclusions are not confirmed. C. B. A.

2277. Excitation of the Visible Spectrum of Helium. J. S. Townsend and F. L. Jones. *Phil. Mag.* 11. *pp.* 679–685, *March,* 1931.—A d.c. discharge was passed through helium in a tube in which the pressure could be varied. The light emitted passed through a filter and fell upon a selenium cell, the current at various pressures being adjusted to give the same response from the cell. It is concluded that the spectrum is excited by electrons having a mean energy of 3 to 4 volts in contradiction to energy exceeding 20 volts as required by the Bohr atom. F. S.

2278. Regularities in the Second Spectrum of Xenon. C. J. Humphreys, T. L. de Bruin and W. F. Meggers. *Bureau of Standards, J. of Research,* 6. *pp.* 287–293, *Feb.,* 1931.—The ground doublet ($^2P^{\circ}_{1\frac{1}{2},\frac{1}{2}}$) in the spectrum of ionised xenon (XeII) has been identified among lines observed in the Schumann region by Abbink and Dorgelo [see Abstract 1295 (1928)]. The levels are separated by 10,540 wave numbers. This spectral term has been connected with others which combine so as to give lines in the visible XeII spectrum, and the absolute values of the terms have been fixed by extrapolating series forming terms to their limits. The ionisation potential of Xe^+ is found from these spectroscopic data to be approximately 21·1 volts. A partial list of identified terms and their combinations is given. AUTHORS.

2279. Spectra of Sulphur. J. Gilles. *Ann. de Physique,* 15. *pp.* 267–410, *March,* 1931.—The spectra were excited in a heated Pyrex tube containing powdered sulphur and were photographed, using various prism and grating spectrographs. The Zeeman effect was also observed for 55 lines of SII and 51 lines of SIII in a field of 31,700 gauss. Various multiplets have been found and the structures of the spectra are discussed. An alternative method of analysis is explained and applied in which the energy values of the ions are used in place of term values and deviations. [See also following Abstract.] F. S.

2280. Internal Energy of the Triple and Quadruple Terms 3*s*P, 3*p*P, 3*p*D. J. Gilles. *Comptes Rendus,* 192. *pp.* 350–352, *Feb.* 9, 1931.—Following the alternative method of analysis of spectra proposed [see preceding Abstract], relations are traced between these multiple terms in the spectra of C, N, O, F at various degrees of ionisation. F. S.

2281. Rotational Analysis of the S_2 Bands. S. M. Naudé and A. Christy. *Phys. Rev.* 37. *pp.* 490–506, *March* 1, 1931.—The emission spectrum of S_2 has been obtained by means of a Geissler tube, the plates being taken in the third order of a 21-foot concave grating giving a dispersion of 0·878 Å. per mm. The following bands have been studied: 9–1(λ2857·36), 7–0(λ2860·13), 8–1(λ2887·84), 9–2(λ2917·38) and 7–1(λ2920·28). Each band consists of three R and three P branches. For small values of K each band appears to have a weak and a strong R branch and a weak and a strong P branch. The lines of the strong branches separate into two components for $K \geq 25$. This structure is similar to that of the Schumann-Runge bands of O_2. It is concluded that the S_2

bands investigated are due to a ${}^3\Sigma_u^- \rightarrow {}^3\Sigma_g^-$ transition (like O_2). The values of B''_e and B'_e (by extrapolation) are 0·409 and 0·319 cm.$^{-1}$, respectively, the nuclear separation of the lower state being $r''_e = 1\cdot603 \times 10^{-8}$ cm. and of the upper state $r'_e = 1\cdot814 \times 10^{-8}$ cm. It is shown that the rotational levels with odd K values are missing in the upper state and those with even K values in the lower state. The fact that alternate levels are missing shows that the internal angular momentum of the S^{32} nucleus is zero. AUTHORS.

2282. Interpretation of Certain ${}^2\Delta$, ${}^2\Pi$ Bands of SiH. R. S. Mulliken. *Phys. Rev.* 37. *pp.* 733–735, *March* 15, 1931.—It is shown that Jackson's ${}^2\Delta$, ${}^2\Pi$ SiH bands [see Abstract 2545 (1930)] have a *regular* ${}^2\Pi$ state and thus are closely analogous to the λ4300 bands of CH. The orbit-spin coupling coefficient A is determined for the ${}^2\Pi$ state of SiH and shown to agree closely with A of the ${}^3P$ state of the Si atom, from which the ${}^2\Pi$ molecular state is supposed to be derived. This is a new example of a relation which seems to be universal. Another new example of the same relation, found in BeH, is also cited.—The coefficients A and B of the ${}^2\Delta$ state and B of the ${}^2\Pi$ state of SiH are also discussed. AUTHOR.

2283. Temperature Determination from Band Spectra in Discharge Tubes. Part II. W. Lochte-Holtgreven. *Zeits. f. Physik*, 67. 9–10. *pp.* 590–600, *Feb.* 14, 1931.—Quantitative measurements of intensity in band spectra show that the C_2 and CH bands evoked in different hydrocarbons in discharge tubes have rotations corresponding to high temperatures (of the order of 1000° Abs.) and that the C_2 and CH bands differ greatly in this respect. In acetylene the C_2 bands correspond to 4700° Abs., and the CH bands to 2000° Abs. In ethylene the corresponding temperatures are 3800° Abs. and 1600° Abs. These temperatures are brought into harmony with the expected collision processes in the hydrocarbons. [See also Abstract 598 (1931).] A. C. M.

2284. Selective Excitation of the OH Bands in the Afterglow of Air. M. Kaczyńska. *Zeits. f. Physik*, 67. 9–10. *pp.* 601–604, *Feb.* 14, 1931.—In air mixed with water vapour, the spectrum of the afterglow excited by the electric discharge shows the presence of the OH band 3064 Å. Of the twelve branches of the band seen in the spectrum during excitation, only three, P_2, Q_2 and R_2, are seen in the afterglow, and the intensity distribution is quite different in the two spectra. J. E.

2285. Band Spectra of Scandium, Yttrium and Lanthanum Monoxides. W. F. Meggers and J. A. Wheeler. *Bureau of Standards, J. of Research*, 6. *pp.* 239–275, *Feb.*, 1931.—The arc spectra of these metals are accompanied by band-spectra which from their appearance are attributed to ScO, YtO and LaO rather than to the stable oxides Sc_2O_3, Yt_2O_3 and La_2O_3. The spectra were photographed with 21-ft. radius-gratings, and tables of wave-lengths are given. For ScO, 139 band heads have been identified and divided into 5 systems. In the YtO spectrum 120 band heads have likewise been divided into 5 systems, while in the case of LaO more than 300 band heads have been measured and divided into 9 systems. F. S.

2286. Natural Width of the D-Lines of Sodium. M. Weingeroff. *Zeits. f. Physik*, 67. 9–10. *pp.* 679–698, *Feb.* 14, 1931.—A new method is described depending upon a combination of magnetic rotation of the plane of polarisation with light absorption. The value found, $0 \cdot 62 \times 10^8$ sec.$^{-1}$, agrees with the theoretical, and it is shown as indicated in earlier work [see Abstract 317 (1928)] that there is hyperfine structure in weak fields of about 30 gauss. The rotation in these weak fields is practically proportional to that in fields of about 1000 gauss. F. S.

2287. Recombination into the 1^2S State of Cæsium. C. Boeckner. *Bureau of Standards, J. of Research,* 6. *pp.* 277–285, *Feb.,* 1931.—Measurements were made of the intensity distribution in the continuous emission band, appearing at the 1^2S series limit of cæsium, using a low-voltage thermionic discharge in the vapour as a source. The wave-length range covered lies between the series limit 3184 Å. and about 2750 Å. The methods of photographic densitometry were used and a tungsten strip lamp in quartz served as comparison source. The probability of recombination into the 2^2P and 3^2D states has previously been shown to vary approximately as the square of the velocity of the free electron. In the case of the 1^2S state, for electron energies greater than $0 \cdot 15$ volt the rate is now found to be nearly as the inverse fourth power of velocity. F. S.

2288. Band Spectra of Tin Oxide. Part I. P. C. Mahanti. *Zeits. f. Physik,* 68. 1–2. *pp.* 114–125, *March* 11, 1931.—The wave-lengths of the heads of the tin oxide bands have been measured, between λ3200 and λ4600, in the second order spectrogram of a 6-ft. Rowland concave grating. Practically all the bands have been arranged in three systems: A, B and C. The values are given of ν_e the change of the energy of the electron (the zero position of a band system), ω_e' the mechanical vibrational frequency for vanishing amplitude (upper electronic state), ω_e'' the same for the lower electronic state, $\omega_e'x_e'$ and $\omega_e''x_e''$, all factors in the equation for the values of ν, the wave numbers of the zero positions, or practically the heads of the three systems. The true vibrational quantum number is a whole number $v = 0, 1, 2 \ldots$ while the effective number is $u = v + \frac{1}{2}$. The author concludes that the lower state of the C system is the ground state of the molecule. The heat of dissociation calculated from this state is $3 \cdot 66 \pm 0 \cdot 1$ volt, which agrees well with the thermodynamic value. An account is given of the details of the molecular structure of SnO. H. N. A.

2289. Arc Spectrum of Rhenium. W. Meidinger. *Zeits. f. Physik,* 68, 5–6. *pp.* 331–343, *March* 24, 1931. *From the Reichsanstalt.*—The spectrum has been measured from 2600 to 3500 Å., and from 4040 to 5300 Å.; the nitrogen bands in the arc made it impossible to work in the intervening region of the spectrum. Powdered metallic rhenium was used, and was placed in a hole drilled in the lower (positive) carbon of the arc. The special carbons contained a small amount of iron, and since rhenium has a high melting-point, 3410° C., the iron lines showed up more strongly in the spectrum than those of rhenium. The mixed spectrum was compared with the spectrum of pure iron, obtained by using very fine iron powder in the hole in the lower carbon. A quartz spectrograph was used for short wave-lengths, and a glass one for the long ones. The wave-lengths of the rhenium lines were determined by interpolation from those of the two nearest Fe lines in each case. Tables are given showing the full details. H. N. A.

2290. Intensity Measurements in the Spectrum of Manganese. R. S. Seward. *Phys. Rev.* 37. *pp.* 344–361, *Feb.* 15, 1931.—Relative intensity measurements have been made for the lines of 25 multiplets of manganese, containing about 150 lines in all. All but three of these were of MnI. None of the MnII multiplets measured were found to contain lines of abnormal intensity. On the other hand, at least eight multiplets of MnI contain lines which are clearly anomalous. These eight multiplets contain a large number of the strongest lines of the spectrum. All involve terms derived from the term a^5D of MnII, and are of the inverted type with wide separations between the sub-terms. There seems to be regularity in the departure from normal intensities which can best be described by graphs in which the calculated intensities are plotted against the measured intensities on double logarithmic paper. In these plots, the satellites often assume a regular pattern above or below the main diagonal lines. The total relative intensities of 17 of these multiplets have also been measured. After reasonable excitation corrections have been applied, the agreement of their intensities with the theoretical values is as close as is to be expected. The measurements on the quartet triad of this group are the most reliable. AUTHOR.

2291. Intensity Measurements of the Multiplet z^5G — e^5F of Nickel. W. A. M. Dekkers and A. A. Kruithof. *Zeits. f. Physik*, 66. 7–8. *pp*. 491–493, 1930.—The intensity relations existing in the multiplet z^5G—e^5F of nickel have been studied under varying conditions. The deviation from the summation rule observed by Ornstein and Bouma [see Abstract 149 (1931)] has been confirmed. F. J. W.

2292. Variation of Intensity of Spectral Lines of Cd and Zn with the Volt Velocity of the Electrons when Excitation is Due to Collisions with Electrons. K. Larché. *Zeits. f. Physik*, 67. 7–8. *pp*. 440–478, *Feb*. 6, 1931.—The author has measured the excitation functions of 42 Cd and 32 Zn lines, between 3·8 and 500 volts of electron velocity. The results agree with those of Schaffernicht for Hg. All lines have a point of maximum light output, and the lines of the $^1S_0$ terms have two maxima, like the corresponding Hg lines. Unlike Hg, Cd and Zn have only one maximum in the lines of the $^3D_2$ terms. This difference is due to the exceptional position of Hg in the series Zn — Cd — Hg. In addition to the above measurements the relative intensity ratios of the lines of Cd and Zn have been determined between 6500 and 2300 Å. for different voltages. The Ornstein-Burger intensity rules have been confirmed for seven triplets and two spark doublets. A connection between the " length of life " of a line and the " breadth " of the maximum of its excitation function curve has been discovered, and an explanation has been attempted. The doubled maxima of the excitation functions of the lines of the $^1S_0$ terms are ascribed to two different lengths of life for these terms. H. N. A.

2293. Measurements of Intensity in the Atmospheric Oxygen Band 7600 Å. W. H. J. Childs and R. Mecke. *Zeits. f. Physik*, 68. 5–6. *pp*. 344–361, *March* 24, 1931.—Intensity measurements of the A group, 7600 Å., have been made photographically, using the method of Frerichs. By using high dispersion and great resolving power (2·6 Å./mm., and 80,000), it is possible to reduce the deviations from Lambert's exponential law to a minimum. It was possible, using three different thicknesses, 13·70, 32·80 and 62·35 m., of air layer, to determine these deviations, and by correction to zero thickness to use them in calculating the intensities. The relative intensities of the lines in the four branches R_1, R_2, P_2 and P_3 of the O_2 bands can then be obtained with an accuracy of 2 %. With certain assumptions as to the form of the absorption lines the absolute absorption coefficients can be estimated, and thus the mean duration of life of excited $^1\Sigma$ term can be estimated at about 7 sec.; in this way it can be shown, what was already suspected, that the $^1\Sigma$ term of the atmospheric oxygen bands is metastable. The results are applied to the question of the proportion of the different isotopes in ordinary oxygen [see following Abstract]. H. N. A.

2294. Atomic Weight of Oxygen and Ratio between the Amounts of the Three Isotopes. R. Mecke and W. H. J. Childs. *Zeits. f. Physik,* 68. 5–6. *pp.* 362–377, *March* 24, 1931.—A zero method is employed, in which lines of equal intensity in the atmospheric oxygen bands A (due to $O^{16}O^{16}$) and A′ (due to $O^{16}O^{18}$) are compared with one another, making use of the previously determined law for the relation between the intensities of the different lines in the same band [see preceding Abstract]. In this way the ratio between the amounts of the isotopes O^{16}, O^{18} and O^{17} has been determined as 630 ± 20 : 1 : 0·2. Taking the atomic weight of the isotope O^{16} as sixteen the atomic weight of ordinary oxygen (the mixture of the isotopes) is then 16·0035 ± 0·0003. To reduce atomic weights determined by the mass spectroscope to chemical atomic weights the formula $A_{mass} = A_{chem} \times 1\cdot00022$ is to be employed. The values obtained differ very considerably from those of Babcock and of Naudé. Suggestions are made as to the reasons for this. The authors regard their own results as more satisfactory, though only provisional. H. N. A.

2295. Measurements of Intensity in Certain Hyperfine Spectral Structures of CdI in Relation to Nuclear Moment and Ratio between the Isotopes. H. Schüler and J. E. Keyston. *Zeits. f. Physik,* 67. 7–8. *pp.* 433–439, *Feb.* 6, 1931.—Schüler and Brück, working on the hyperfine structure of the CdI triplet $^3P_{0,1,2}$ — $^2S_1$ ($\lambda\lambda$ = 4678, 4800, 5086), have concluded that the Cd isotopes have nuclear moments of 0 and ½. The experimental result is in good agreement with the theoretical level scheme, but previous intensity measurements by different experimenters disagree with the results of theory. The authors have made new measurements of the intensity relations, using hyperfine structure photographs taken by means of the discharge tube previously described by Schüler, and the results of these agree well with the theory. It appears clear that the results obtained by other observers are vitiated by the fact that certain hyperfine structure terms were, in their experiments, influenced by the conditions under which the discharge took place; and it is shown that the anomalies in intensity in all cases vary with the shift of the terms. It is shown that the proportional amount of the isotopes in which the splitting of the lines indicates a nuclear moment $i = \frac{1}{2}$ is 23 % of the total. H. N. A.

2296. Relations between Occurrence Ratios of Isotopes and between Nuclear Moments of Some Elements. H. Schüler and J. E. Keyston. *Zeits. f. Physik,* 68. 3–4. *pp.* 174–177, *March* 20, 1931.—The occurrence ratios of the isotopes of the elements Cr, Zn, Ge, Mo, Cd, Hg and Pb exhibit certain relationships to one another, if the isotopes are considered as divided into groups of even and uneven atomic weight. If these relations are not merely accidental, the conclusion can be drawn that the isotopes of an element have originated rather as a result of a distribution process within an element than of a simple building-up process from one isotope to another. In the case of Cd these isotope groups can be connected with the nuclear moments ½ and 0. This connection between isotope groups and nuclear moments is extended to other elements, and the deduction is made that large nuclear moments should be possessed by elements consisting of only one isotope. A table of nuclear moments is given which shows that this deduction finds experimental confirmation. J. E. K.

2297. Isotope Effect in Thallium Hyperfine Structure. H. Schüler and J. E. Keyston. *Naturwiss.*, 19. *pp.* 320–321, *April* 10, 1931. *Zeits. f. Physik*, 70. 1–2. *pp.* 1–9, *June* 20, 1931.—The authors report the discovery that several lines in the arc and spark spectra of thallium possess more hyperfine-structure components than theory requires. The number, position and intensities of the hyperfine-structure components are completely explained by the assumptions that thallium possesses two isotopes, 205 and 203, both with nuclear moment $i = \frac{1}{2}$, and that the hyperfine-structure energy-levels of these two isotopes are displaced relatively to one another. The required ratio of occurrence of the two isotopes 205 and 203 is 2·3 : 1, which gives excellent agreement with the atomic weight 204·39. The largest relative isotope-term displacements are found in the case of levels with relatively small separations. J. E. K.

2298. Mass Spectra of Glasses, Salts and Metals by Means of a Circular Mass-Spectrograph. H. Murawkin. *Ann. d. Physik*, 8. 3. *pp.* 353–384, *Feb.* 19, *and* 9. 8. *pp.* 974–980, *June* 17, 1931.—A circular mass-spectrograph is described which is based on the author's earlier investigation of the methods of improving the line-intensity and resolution of mass-spectra [see Abstract 1922 (1931)]. By using a special intensity curve it is possible to obtain theoretically any desired accuracy. The spectrograms are recorded galvanometrically. H. L. B.

2299. Theory of Hyperfine Structure Separations. S. Goudsmit. *Phys. Rev.* 37. *pp.* 663–681, *March* 15, 1931.—Expressions are derived for the hyperfine structure separations of the levels of complicated electron configurations in different types of coupling. The few available experimental data are in distinct disagreement with the theoretical calculations. This undoubtedly means that our present knowledge of the interaction with nuclear spin is incomplete. The expressions in this article are derived by the well-known method of the invariance of energy sums. AUTHOR.

2300. Hyperfine Structure of Li$^+$. Part II. P. Güttinger and W. Pauli. *Zeits. f. Physik*, 67. 11–12, *pp.* 743–765, *Feb.* 25, 1931.—In Part I [see Abstract 488 (1931)] it has been shown that the diagram arrived at by Schüler for the splitting up of the line $2s - 2p$ of ortho-Li$^+$ 7 can be theoretically explained. There are, however, some small discrepancies between theory and experiment, and in the present paper the distances between the components and the intensities are calculated more accurately for the $^3P_{0,2,1} - {}^3S_1$ triplet of Li$^+$ 7. Since in this case the hyperfine structure is of the same order of magnitude as the fine structure, the elements of the matrix of the energy depending on the nuclear moment which are not diagonal with relation to j must not be neglected. This appears very clearly in the new intensities found for P_1 to S and P_2 to S, which differ by 40 % from those previously found, while the intensity for P_0 to S remains unaltered. The agreement between the results of the new theory and Schüler's experimental results is very satisfactory. The relation between the theoretical and experimental intensities for the Li6 and Li7 lines is also improved, though there is still a discrepancy. In a supplement an elementary deduction is given for the known formulæ for multiplet intensities, using the method of matrices. H. N. A.

2301. Time of Relaxation of Excited Atoms and Hyperfine Structure of the Mercury-Arc Spectrum. S. Mrozowski. *Zeits. f. Physik*, 68. 3–4. *pp.* 278–283, *March* 20, 1931.—It is shown on the basis of the summation rule that the times of relaxation for different levels that belong to a multiplet term are approximately equal if transitions are permissible from these levels to levels that belong to the same system of terms. The differences in the times of relaxation are caused by the inter-combination transitions. By applying this rule in discussing the possible influence of the nuclear moment of momentum in the case of the mercury triplet $2^3P - 2^3S_1$ the author shows that the anomalous long time of radiation which has been found by Randall and Richter for the $2^3P_2 - 2^3S_1$ line cannot be due to this influence. H. L. B.

2302. Radiation of Multipoles. K. F. Herzfeld. *Phys. Rev.* 37. *pp.* 253–259, *Feb.* 1, 1931.—The radiation of multipoles formed by putting together elementary dipoles is investigated according to the classical theory and wave mechanics. It turns out that the radiations are of two kinds: The first part has the same frequency as the dipoles and is present only if the multipole structure is present even without vibration. The second part is always present. If n, the order of the multiple, is even then the frequencies are 2ν, 4ν, up to $n\nu$. If n is odd, then the frequencies are ν, 3ν, up to $n\nu$. The relative intensities of subsequent multipoles are proportional to the square of the ratio: dipole amplitude to wave-length, as has been found in other cases. This calculation would apply to the infra-red radiation of molecules. AUTHOR.

2303. Raman Spectra of Some Organic Halides. C. E. Cleeton and R. T. Dufford. *Phys. Rev.* 37. *pp.* 362–372, *Feb.* 15, 1931.—Raman spectra obtained by helium excitation from 19 organic compounds, $CHCl_3$, CH_3Br, CH_3MgBr, CH_3I, CH_3MgI, C_2H_5Cl, C_2H_5Br, C_2H_5I, $ClCH_2CH_2Cl$, $BrCH_2CH_2Br$, CH_3CHCl_2, CH_3CHBr_2, $C_2H_2Cl_4$, $C_2H_2Br_4$, C_6H_6, C_5H_5N, $C_6H_5CH_2Cl$, C_6H_5Cl, C_6H_5Br, five of which have not been reported on before, are described and discussed. It is shown that in many cases the observed frequencies can be expressed in terms of four assumed fundamentals (five in the cyclic compounds), two of which are not observed and which may prove to be illusory. The bearing of such theory as is available is discussed. AUTHORS.

2304. Modified Scattering by Hydrogen Halides. E. O. Salant and A. Sandow. *Phys. Rev.* 37. *pp.* 373–378, *Feb.* 15, 1931.—Raman lines of the gases of HCl, previously measured by Wood [see Abstract 3039 (1929) and 3440 (1930)], of HBr and HI and of the liquids of HCl and HBr have been measured. The Raman shifts of the lines of HCl and HBr gases agree with the infra-red bands. The Raman shift of HI, 2233 cm.$^{-1}$, does not agree with the infra-red value, and is considered the more accurate determination of the (0,1) vibrational transition for HI. Intensities of scattering are in the reverse order of intensities of absorption, as might be expected from the Hill-Kemble theory of scattering by diatomic molecules of gases. The Raman lines scattered by the liquids show a different appearance from the lines scattered by the gases and their Raman shifts are smaller. The differences in the shifts are much too large to be attributed to a Lorentz-Lorenz force, and are evidence of molecular interactions of a purely quantum mechanical nature, as discussed by Breit and Salant [see Abstract 492 (1931)]. AUTHORS.

2305. Raman Lines of Cyclopropane and Valence Properties of Some Organic Compounds. R. C. Yates. *Phys. Rev.* 37. *pp.* 616–618, *March* 1, 1931.—Three fundamental wave-numbers for C_3H_6 are calculated from the equations of motion of a system of three particles vibrating in a plane. The character of a single bond acting adjacent to a double bond in CH_3CHO and again to a triple bond in CH_3CN is studied. [See also Abstract 39 (1931).] AUTHOR.

2306. Raman Effect and Chemical Bonds. L. E. Howlett. *Canad. J. of Research*, 4. *pp.* 79–91, *Feb.*, 1931.—The paper gives a brief review of what the new mechanics has done to explain the phenomenon of incoherent scattering. An expression is derived for the frequencies characteristic of three elastically bound masses vibrating in a straight line. This simple harmonic theory is used to assist in interpreting experimental results. The value of the stretching force of all single bonds is assumed to be the same. Double and triple bonds are taken as having a stretching force twice and three times respectively that of a single bond. The value of the stretching force of a single bond is deduced with the aid of the assumption that the frequency 300 mm.$^{-1}$ arises from longitudinal oscillations of the form C—H. Spectrograms are given together with diagrams and measurements for two groups of substances: (1) ethylene glycol and five derivatives, (2) four nitriles and benzyl alcohol. Acetonitrile, phenylacetonitrile and benzyl alcohol have been studied by other authors. The rest are observed for the first time. With the aid of the simple harmonic oscillator theory previously mentioned some attempt is made to associate frequencies with definite bonds and structures. AUTHOR.

2307. Raman Effect in Water. I. R. Rao. *Roy. Soc., Proc.* 130. *pp.* 489–499, *Feb.* 3, 1931.—Exact wave-length determinations are made of the Raman bands in water, in the visible and ultra-violet. The maximum lies at $2\cdot92\,\mu$ and the two extremes at $2\cdot75\,\mu$ and $3\cdot24\,\mu$. When electrolyte is added, the band sharpens and shifts towards $2\cdot70\,\mu$. With high concentrations a second maximum appears at about $2\cdot79\,\mu$. As temperature increases, the intensity diminishes on the long wave-length side, and increases on the short wave-length side. This is explained as being due to changes in the proportion of single, double and triple molecules. The diminution of intensity on the long-wave side is attributed to diminution in amount of triple molecules, while the increase in intensity on the short-wave side will be due to the corresponding increase in single molecules. This is confirmed by infra-red investigations. The development of the second maximum with concentrations of nitric acid higher than 7 % is attributed to the formation of hydrates. [See also Abstract 136 (1929).] A. C. M.

2308. Raman Effect in Solutions. Part II. H. Braune and G. Engelbrecht. *Zeits. f. phys. Chem.* 11. *Abt. B.* 5–6. *pp.* 409–429, *Feb.*, 1931. Describes results of experiments on solutions of HgI_2, $Hg(CN)_2$, K_2HgCl_4, K_2HgBr_4, K_2HgI_4, $KAgI_2$, $KCdCl_3$, K_2CdI_4, CdI_2, $K_2Hg(CN)_4$,

$KAg(CN)_2$, $K_3Cu(CN)_4$. HgI_2, $HgCl_2$ and $HgBr_2$ give frequencies attributed to the inactive frequency of the linear molecule. The complex mercury halides give spectra very similar to those of the simple halides. A line appears with a somewhat smaller frequency, attributed to the optically inactive vibration of the halogen atoms against the mercury atom. $KCdCl_3$ and $CdCl_2$ give no Raman effect. $KCdI_4$ gives a strong Raman line, which appears weakly in CdI_2. $KAg(CN)_2$ gives a line which may perhaps be due to a vibration of the CN radical against the silver atom. The frequency of the internal CN vibration shows a gradual decrease in the series $Hg(CN)_2$, $K_2Hg(CN)_4$, $KAg(CN)_2$, $K_3Cu(CN)_4$ KCN. [For Part I, see Abstract 498 (1931).] A. C. M.

2309. Polarisation of Raman Lines in Liquids. G. Placzek and W. R. van Wijk. *Zeits. f. Physik*, 67. 9–10. *pp*. 582–589, *Feb*. 14, 1931. Wood's method of illumination in observations of the Raman effect in liquids has the advantage of quickness, but is not the ideal method to employ when investigating degrees of polarisation, since the liquid is illuminated from all angles. Measurements have been made by Cabannes on CCl_4 and benzene, using right-angle illumination; the authors have therefore made measurements on the same liquids, using Wood's method, and have compared their results with Cabannes, thus obtaining a calibration of their apparatus. A. C. M.

2310. Problem of Number of Collisions and the Raman Effect. H. Bartels and C. H. Nordstrom. *Zeits. f. Physik*, 68. 1–2. *pp*. 42–63, *March* 11, 1931.—The collision problem which Harries and Hertz treated on the basis of the diffusion theory permits of formally exact solutions for all densities of the scattering medium if the method given by Bartels for the treatment of electron scattering processes is taken as basis of the calculation, and space free from electric field is considered. In the range of small densities the Harries-Hertz formula holds no more, in particular a pronounced dependence of the number of collisions on the distribution of direction of the electrons entering the medium is found. The expressions for the condition of the number of collisions at small densities render possible, by interpretation of the results in the optical scattering problem, the clearing up of some questions which are of importance with reference to the method of investigation of the Raman effect. Especially investigation is made whether the artificial disturbance of a substance (*e.g.*, by pulverisation) has for consequence an actual raising of the yield. It results that the output under certain circumstances is increased, but to this increase there are strict limits; it is not comparable with the rise of the output which can be obtained by increase of the thickness of the layer or reflection. J. J. S.

2311. Transition Probabilities in the Raman Effect. L. S. Ornstein and J. Rekveld. *Zeits. f. Physik*, 68. 3–4. *pp*. 257–259, *March* 20, 1931.—A formula is deduced connecting the intensities of Stokes and anti-Stokes lines: $I_{S.}/I_{A.S.} = e^{h\nu_{mn}/kT}$. This follows from the experimental observation that the intensity of Stokes lines is proportional to $(\nu - \nu_{mn})^4$ [see Abstract 1042 and 3146 (1930)], where ν is the exciting frequency, and ν_{mn} the Raman shift. A. C. M.

2312. Determination of Dissociation Energies from Predissociation Spectra. L. A. Turner. *Zeits. f. Physik*, 68. 3–4. *pp*. 178–183, *March* 20, 1931.—An explanation is given of the fact that two different types of predissociation spectra exist, in which either a sharp or a gradual transition takes place between sharpness and diffuseness of the fine structure. Reliable values for the dissociation energy can only be obtained in the former case; on the other hand when the transition is gradual one obtains a value which can only be regarded as an upper limit to the dissociation energy. Various experimental results concerning the predissociation of NO_2 are discussed and explained. [See Abstract 1202 (1931).] J. E. K.

2313. Decrease in Intensity of Spectral Lines in Strong Electric Fields. C. Lanczos. *Zeits. f. Physik*, 68. 3–4. *pp.* 204–232, *March* 20, 1931.—The emission lines of hydrogen exhibit a considerable decrease in intensity in a strong electric field before the actual ionisation limit is attained. In a previous paper [see Abstract **3735** (**1930**)] this behaviour was explained as due to an external charge-cloud surrounding the atom. This treatment was a statical one, but it has since been shown that the problem is essentially a dynamical one, in which the life period (*Lebensdauer*) of the excited state plays a decisive part. The problem is therefore re-examined and quantitatively discussed with the aid of wave mechanics, and is described as pre-ionisation. The electric field places the atom in a state of spontaneous ionisation, and therefore excites the complete model for a radioactive decomposition. The higher excited states therefore decompose in a time which is short even in comparison with the life period (*Lebensdauer*) of the excited state, so that the atom does not reach the emissive state and the emission lines must disappear. In the case of hydrogen the problem can be carried out in every quantitative detail. The calculated limits are in good agreement with experiment. J. E. K.

2314. Stark Effect in Band Spectra. W. G. Penney. *Phil. Mag.* 11. *pp.* 602–609, *Feb.*, 1931. *Supplement.*—A theoretical paper in which the cases are indicated in which an appreciable Stark effect may be expected when an electric field is applied to a radiating molecular system. F. S.

2315. Stark Effect in Oxygen. Part II. M. Kiuti, K. Ochiai and Y. Nishimura. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 65–73, *Feb.*, 1931. *In English.*—In previous work the effect was observed in the $2p-5q$ group, and the results obtained agreed with the subsequent calculations of Doi [see Abstract **3150** (**1930**)]. The $2p-6q$ group is now investigated in fields up to 270,000 volts/cm. using both grating- and prism-spectrographs. The results are tabulated and discussed. F. S.

2316. Electrophotophoresis and Magnetophotophoresis. F. Ehrenhaft, M. Reiss and E. Wasser. *Zeits. f. Physik*, 67. 7–8. *pp.* 519–522, *Feb.* 6, 1931.—The phenomenon that sub-microscopic particles irradiated by intensive light and in an uncharged condition move in homogeneous electric or magnetic fields in the direction of the field can be explained if it is assumed that the accommodation coefficient depends on the strength of the electric and magnetic fields. If T_2 is the temperature of the molecules reflected from the wall of a gas enclosure, $T_2 = T + \beta(T_1 - T)$, where T is the temperature of the wall and T_1 that of the molecules striking the wall. The magnitude $1 - \beta = (T_1 - T_2)/(T_1 - T)$ is the so-called accommodation coefficient. J. J. S.

2317. Radiation Emitted by Compressed Crystalline Substances under High Potentials. I. A. Balinkin. *Phil. Mag.* 11. *pp.* 315–322, *Feb.*, 1931.—The experiments of Reboul and others with partially conducting cellules [see Abstracts 144 (1927), 3747 (1930), 1209 (1931)] have been repeated with potash alum, with additional precautions to ensure more perfect compression of the material, and contact thereof with the terminals. The character of the radiation depends on (1) the potential applied, (2) the relative humidity of the atmosphere, (3) the size of the crystal grains, (4) the pressure used in compression. Its range lies between the ultra-violet and soft X-rays. It is due to ionisation of the air in the interstices of the powder, being emitted by the ionised or excited molecules on their return to normal on escaping from the pores of the powder. It is essentially the same as the discharge rays (*Entladungsstrahlen*) of Wiedemann [*Zeits. f. Elektrochem.* 2. *pp.* 155–159, 1895], and the radiation produced when electric currents pass through gases at low pressure [see Abstract 445 (1927)]. C. A. S.

2318. X-Ray Standard Ionisation Chamber Diaphragm System. L. S. Taylor and G. Singer. *Bureau of Standards, J. of Research*, 6. *pp.* 219–228, *Feb.*, 1931.—Further studies have been made [see also Abstract 1476 (1930)] on the effect of the diaphragm system upon the calibration measurements made with the large free air ionisation chamber. Air absorption coefficients were obtained, and it was found necessary to use these values to correct the ionisation chamber readings. Calibrations of a thimble chamber, made with and without a restricting diaphragm close to the X-ray tube, differ by several per cent. Dependent upon the position of the thimble chamber with respect to the tube target, the calibration may vary over a range of 10 %. When the radiation is not restricted by a diaphragm close to the tube, there may be a difference in the radiation quality received by the thimble and air chamber, as large as 10 %. AUTHORS.

2319. Quantitative Chemical Analysis by means of Absorption of X-Rays. N. H. Moxnes. *Zeits. f. phys. Chem.* 152. *Abt. A.* 5–6. *pp.* 380–408, *Feb.*, 1931.—The application of a photographic-photometric method to the measurement of the absorption of X-ray spectral lines is described. With zinc and nickel the method gives unsatisfactory results. T. H. P.

2320. Dependence of X-Ray Absorption Spectra upon Chemical and Physical State. J. D. Hanawalt. *Phys. Rev.* 37. *pp.* 715–726, *March* 15, 1931.—The X-ray absorption spectra of As, Se, Br, Zn, Hg, Xe and Kr, and of compounds of some of these elements have been photographed for both the solid and the vapour states at a dispersion of about 5 X.U. per mm. The effect of the chemical and physical state of the absorbing atom upon the secondary structure which lies to the short wave-length side of the main absorption edge was investigated. It was found that: (1) The monatomic vapours Zn, Hg, Xe and Kr exhibit no secondary structure at distance from the main edge greater than the ionisation potential of the atom. (2) Polyatomic vapours usually, though not necessarily, have a secondary structure similar to that which is exhibited by the same molecule in the solid state. (3) For a polyatomic molecule in the solid state there is often an additional structure observed which is absent when the molecule is in the vapour state. (4) There is an additional structure in the secondary absorption of solid $NaBrO_3$ which is not observed in a solution of $NaBrO_3$. (5) Completed electron shells of atoms in the solid state do not necessarily mean the absence of secondary absorption edges as has been suggested. In order to account for this dependence of secondary absorption on molecular and physical state it is suggested that perhaps the secondary discontinuities correspond to the excitation energies of the structure electrons postulated by Richardson [see Abstract 4037 (1930)]. AUTHOR.

2321. Selection Rules in X-Ray Absorption Spectra. M. Siegbahn. *Zeits. f. Physik*, 67. 9–10. *pp.* 567–571, *Feb.* 14, 1931.—It is shown that selection rules exist for the frequencies of the absorption edges, just as for emission-lines, and these are discussed with examples. A. C. M.

2322. Intensity of X-rays Reflected from Platinum, Silver and Glass. H. W. Edwards. *Phys. Rev.* 37. *pp.* 339–343, *Feb.* 15, 1931.—The intensity of a monochromatic beam of X-rays reflected from platinum, silver and glass mirrors was measured for angles of incidence varying from 0·75 to 1·25 times the critical angle. Radiation having a wavelength of 0·69 Å. was obtained by reflection from calcite. Values of the intensity of the reflected beam calculated by Thibaud's modification of Fresnel's equation were found to be in good agreement with experimental values obtained from platinum. Experimental results obtained from silver and glass mirrors do not agree quantitatively with the theoretical values. No explanation for the lack of concordance is offered. AUTHOR.

2323. Dispersion of X-Rays. E. Nähring. *Phys. Zeits.* 32. *pp.* 179–180, *Feb.* 15, 1931.—The author reviews his previous paper [see Abstract 3466 (1930)] in the light of a recent dissertation of Axel Larsson upon the same subject. B. J. L.

2324. Frequencies of Characteristic X-Rays of Elements 11 (Na) to 19 (Cl) Calculated on a Classical Theory Basis. S. Björck. *Zeits. f. Physik*, 68. 1–2. *pp.* 133–144, *March* 11, 1931.—The Rutherford-Bohr atom model is modified with the help of certain assumptions so that the mechanical frequencies of the electrons (K_ω, L_ω, M_ω, etc.) coincide with the " electromagnetic " absorption frequencies (K, L, M, etc.), the following equations being true: $\epsilon_k = h\mathrm{K}$, $\epsilon_l = 2h\mathrm{L}$, $\epsilon_m = 3h\mathrm{M}$, etc., where ϵ_k, ϵ_l, ϵ_m, etc., are the kinetic energies of the K-, L-, M-electrons. The electrons are considered as distributed in radiationless orbits; but it is assumed that radiation occurs when the electrons are disturbed (eccentricity > 0). A vibration (frequency $\mathrm{K}-\mathrm{L} = \mathrm{K}_\alpha$, etc.) is then emitted while the successive rings of electrons return to their radiationless orbits. An effective quantum number and an effective charge are introduced, and also a " magnetic " frequency which is related with a proposed new interpretation of the Kaufmann experiments. C. B. A.

2325. X-Ray Interference in Gases. H. Gajewski. *Phys. Zeits.* 32. *pp.* 219–221, *March* 1, 1931. *Paper read before the Deut. Phys. Gesellsch., Dresden, Jan.*, 1931.—Experiments on N_2, O_2, CO_2, NH_3, CS_2, H_2O. The Thomas-Fermi formula gives quite a good approximation to the electron-distribution. Under constant atom distances the interference effect is better the smaller the characteristic atom radius. Under the greater atom distances the interference effect is better for a given atom radius. Calculations of certain atom distances are given. A. D.

RADIOACTIVITY.

2326. Radioactive Groups. E. L. Harrington. *Comptes Rendus,* 192. *pp.* 414–415, *Feb.* 16, 1931.—The groups of radioactive atoms formed in gaseous mixtures containing radon consist of radioactive atoms and a large number of polar molecules grouped round the nucleus. The latter is usually a stable association of radioactive atoms having a low vapour tension. E. E. F. d'A.

2327. Molecular Aggregates in Radon-Gas Mixtures. E. L. Harrington and O. A. Gratias. *Phil. Mag.* 11. *pp.* 285–296, *Feb.*, 1931. —By various methods gaseous mixtures containing radon and its decay products have been investigated for the presence of molecular aggregates. Since in every case studied aggregates were obtained when the mixture contained polar molecules, and since in no case were aggregates detected when only nonpolar molecules were present, it would appear that polar molecules definitely favour and are possibly essential in the formation of large aggregates in gaseous mixtures containing radon. AUTHORS.

2328. New Method of Radioactive Investigation of Pulverised Substances. F. Běhounek. *Zeits. f. Physik,* 68. 3–4. *pp.* 284–285, *March* 20, 1931.—Remarks on W. Šebesta's paper. [See Abstract 1580 (1931).]

2329. Colouring and Luminescence by Becquerel Rays. K. Przibram. *Zeits. f. Physik,* 68. 5–6. *pp.* 403–422, *March* 24, 1931.—A review of the work of recent years on colouring and luminescence [see Abstract 2081 (1927)]. In rock-salt there are supposed to exist two kinds of centres: colouring centres (FZ) consisting of a neutral atom together with its surrounding and distorted neighbours which influence its motions and absorption; and decolouring centres (VZ) consisting of a kation with its distorted neighbours, one at least of which is an anion which easily loses an electron to the kation. FZ may be converted into VZ by radiation or by the introduction of a new metal atom by metal vapour or by electrolysis. Three main classes of centres of each kind are distinguished corresponding to increasing distortion and different energy levels but this classification is only rough, there probably being many intermediate energy levels. The effects of radiation, heat, pressure and light are discussed. These effects consist of reversible transformations of centres from higher to lower energy states and of colouring centres to decolouring centres. The effect of pressure in colouring many white salts or of making them sensitive to light (piezochromy) is referred to and the colour of many natural minerals such as fluorite is attributed to radioactive radiations. The piezochromy of certain minerals is attributed to previous pressure experiences and consequent development of centres. The well-known effects of pressure on the luminescent output of many substances are taken as an indication that the luminescent centres are to be identified with the centres indicated above. J. E.

2330. Range Groups of H-Particles from Aluminium. H. Pose. *Zeits. f. Physik,* 67. 3–4. *pp.* 194–206, *Jan.* 21, 1931.—Further investigation was made of the three groups of H-particles liberated from Al by

α-particles from polonium [see Abstract 532 (1931)]. The dependence of yield and energy of the H-particles on the angle between primary and secondary ray was examined. It follows from the measurements that the yields in the backward direction are about 30 % smaller than those in the forward direction. The velocities of the H-particles calculated from the ranges diminish with increasing angle between primary and secondary ray, corresponding to the change consequent upon the energy and impulse principle. The results are in good agreement with the ideas based on the point of view of quantum mechanics as to the penetration of the Al nucleus by an α-particle. J. J. S.

2331. Artificial Disintegration by α-Particles. J. Chadwick, J. E. R. Constable and E. C. Pollard. *Roy. Soc., Proc.,* 130. *pp.* 463–489, *Feb.* 3, 1931.—The protons emitted by certain elements when bombarded by α-particles have been examined by an electrical method. Polonium was used as the source of α-particles, and the emitted protons were observed both in the direction of the incident α-particles and at right angles to it. It was found that, except in the cases of fluorine and sodium, the disintegration protons consisted of distinct groups. The origin of these groups is explained on the assumption that the protons and α-particles contained in a nucleus are in definite energy levels. Information about the position of these levels is obtained from an examination of the experimental results. The mass defects of certain nuclei formed in the disintegration processes are deduced. Some points of general interest in the problem of artificial disintegration are discussed. AUTHORS.

2332. Anomalous Scattering of α-Particles by Light Nuclei. T. Sexl. *Zeits. f. Physik,* 67. 11–12. *pp.* 766–779, *Feb.* 25, 1931.—Born's method for dealing with collision problems is applied to the anomalous scattering of α-particles by light nuclei. Applying, however, a criterion due to Mott, it appears it is not permissible to confine oneself to the first approximation of Born's procedure in the investigation of the potential distribution. The result then is that, using this approximation, it is not possible to obtain a satisfactory formula which represents the experimental results. Calculations show that even in the first approximation h enters explicitly into the formula, so that no conclusion can be arrived at from the former classical calculations of the problem. It is also found that the assumption of a polarisation of the nucleus is not necessary for the explanation of anomalous scattering. H. N. A.

2333. Absorption of β-rays by Matter. G. Fournier and M. Guillot. *Comptes Rendus,* 192. *pp.* 555–557, *March* 2, 1931.—Using an improvement of the method described previously [see Abstracts 2633 and 2888 (1926)] the following mass-absorption coefficients (μ/ρ) for β-rays from radium (D + E) have been determined: Boron (amorphous) 16·1, phosphorus, white, solid or liquid 20·9, red 20·2; vanadium 19·7; arsenic 20·9; bromine 23·0; sodium (in slabs obtained by pressure and covered with a layer of oil) 16·8. The metalloids do not, whilst sodium does, agree with the relation $\mu/\rho = 15 + 0{\cdot}142\,\mathrm{N}$, where N is the atomic number. C. A. S.

2334. Scattering of Hard γ-Rays. Part II. L. H. Gray. *Roy. Soc., Proc.* 130. *pp.* 524–541, *Feb.* 3, 1931.—A preliminary investigation by the author [see Abstract 187 (1931)] is continued. The relative scattering power of the elements Mg, Al, Cu, Zn, Cd, Sn and Pb for RaC γ-rays filtered through 4 cm. of Pb, and thorium C″γ-rays filtered through 3 cm. Pb was investigated by observing the ionisation produced by radiation scattered within the angular range 10° to 30°. In the former case the scattering power of the elements per extra-nuclear electron appeared to show a slight decrease of 2 % between Mg and Pb, and in the latter case a gradual increase of about the same amount, but the difference was of the order of magnitude of the experimental error, and the measurements indicate that the binding forces in heavy elements do not appreciably influence the scattering power of the extra-nuclear electrons for radiation of quantum energy $h\nu \sim 2 \times 10^6$ ε-volts. Since 40 % of the Compton radiation falls within the angular range 10° to 30° the measurements were relatively insensitive to any radiation that might be scattered by the nucleus. Yet it may be concluded that not more than a third of the thorium C″ γ-rays in heavy and light elements can be due to nuclear absorption resulting in the re-emission of approximately isotropic radiation. J. J. S.

2335. Stellar Origin of Cosmic Ultra-Penetrating Radiation. V. F. Hess. *Nature*, 127. *pp*. 10–11, *Jan*. 3, 1931.—Very accurate registrations of the cosmic radiation carried out with Hoffmann's high-pressure ionisation chamber at Muottas Muraigl in the Engadine at 2456 m. above sea-level show that the average intensity of the radiation is somewhat greater in daytime than during the night. From the observations it is concluded that the sun emits penetrating rays of at least the same penetrating power as the cosmic ultra-radiation. The total amount of the solar penetrating rays, at 2456 m. above sea-level, is about 0·5 % of the total intensity of the cosmic radiation. The emission of this penetrating radiation from the sun indicates that all fixed stars are sources of a radiation of similar qualities. [See Abstract 3760 (1930).] J. J. S

2336. Origin of the Penetrating Corpuscular Radiation of the Atmosphere. B. Rossi. *N. Cimento*, 8. *pp*. 49–70, *Feb*., 1931. *Zeits. f. Physik*, 68. 1–2. *pp*. 64–84, *March* 11, 1931.—Experiments were made which confirmed the existence of the penetrating corpuscular rays observed by Bothe and Kolhörster and give an approximate value of the maximum penetration. They seem to indicate that at sea-level there exists also a feeble ultra-γ radiation which generates new secondary corpuscular rays. Two hypotheses are possible: (1) All the observed corpuscular radiation is generated in the terrestrial atmosphere, whilst the primary penetrating radiation is a pure ultra-γ radiation. (2) The penetrating radiation is from its entrance into the atmosphere composed of γ-rays and of β-rays; these last having perhaps been produced in other parts of the universe by the ultra-γ radiation itself. In the first case it follows that the penetrating power of the secondary radiation must be greater than that of the primary radiation, or it would not be possible to establish a régime of equilibrium between the two. From the second hypothesis it may be concluded that the secondary radiation is softer than the primary, and the dependence of the intensity on height is more easily comprehensible. Even if from sidereal regions a pure ultra-γ radiation arrives at the earth the penetrating radiation observed at sea-level is substantially a corpuscular radiation whose properties are not directly connected with those of the ultra-γ radiation there existing. J. J. S.

HEAT.

2337. Method for Determining the Thermal Conductivity of Metals, Particularly at High Temperatures. R. Holm. *Wiss. Veröff. a. d. Siemens-Konzern,* 9. 2. *pp.* 300–311, 1930.—The method is devised for heat conductivity measurements consisting of adaptations of the Kohlrausch, Diesselhorst and Meissner systems, which is specially valuable for experiments with metals at high temperatures. The chief factors concerned are the use of a characteristic measurement curve and test pieces of particular form and dimensions. The heat losses from the sides of the test piece were determined in relation to and in consequence of the radiation and conductivity in the gases surrounding it, as also full investigation is recorded of the time required to attain more or less full temperature equilibrium in the experimental system. Full details, both theoretical and practical, are given in the text. [See following Abstract.]

S. G. B.

2338. Heat Conductivity of a Platinum Rod between 19° and 1020° C. R. Holm and R. Störmer. *Wiss. Veröff. a. d. Siemens-Konzern,* 9. 2. *pp.* 312–322, 1930.—The specific resistance of a 99·95 % pure platinum sample was measured over the temperature range 15° to 1020° C. Over the same range, utilising the method described by Holm [see preceding Abstract] the conductivity of the same platinum sample was also measured. The apparatus used is fully described. The results show the following relationships:

$$\rho = 1\cdot048 \,.\, 10^{-5}[1 + 3\cdot695 \,.\, 10^{-3}(\vartheta - 15) - 5\cdot98 \,.\, 10^{-7}(\vartheta - 15)^2 + 5\cdot25 \,.\, 10^{-11}(\vartheta - 15)^3]$$

$$\kappa = 0\cdot699[1 + 2\cdot83 \,.\, 10^{-4}(\vartheta - 19\cdot5^\circ)]$$

In comparison with other authors the following values are given:

Observers.	Specific Resistance of Pt.			Mean Temperature Ratio with Resistance $\frac{W_{100} - W_0}{100\, W_0}$	Thermal Conductivity of Pt.		Temperature Coefficient of Conductivity $\frac{k_{100} - k_{18}}{82 k_{18}}$
	0°	18°	100°		18°	100°	
Meissner	0·981	1·051	1·367	$3\cdot93 \times 10^{-3}$	0·701	0·706	$0\cdot87 \times 10^{-4}$
Jaeger and Diesselhorst	—	1·082	1·403	$3\cdot84 \times 10^{-3}$	0·696	0·725	$5\cdot08 \times 10^{-4}$
Holm and Störmer	0·990	1·060	1·373	$3\cdot86 \times 10^{-3}$	0·699	0·715	$2\cdot84 \times 10^{-4}$
Dewar and Fleming	—	—	—	$3\cdot67 \times 10^{-3}$	—	—	—
Bridgeman	—	—	—	$3\cdot87 \times 10^{-3}$	—	—	—
Holborn	—	—	—	$3\cdot92 \times 10^{-3}$	—	—	—

S. G. B.

2339. Friction, Heat Conduction, and Diffusion in Gaseous Mixtures. Part XIII. M. Trautz and W. Ries. *Ann. d. Physik,* 8. 2. *pp.* 163–184, *Feb.* 4, 1931.—Wuppermann improved the Stefan-Winkelmann method for the determination of the velocity of vaporisation for the measurement of the diffusion constant, and in the present work first of all the Winkelmann and the Wuppermann methods are compared, finally resulting in the adoption of the latter with trivial amendments. The apparatus is fully described. With the Wuppermann metal diffusion apparatus the diffusion constants of combinations of (C_6H_6 and H_2) as well as (CCl_4 and H_2) are measured. As mean values of the diffusion constant with an experimental error of approximately ± 0·5 to 1·0 % and an absolute uncertainty of two to three times this error, the following figures were obtained: $D_{C_6H_6-H_2} = 0 \cdot 363$ cm.^{2}/sec. and $D_{CCl_4-H_2} = 0 \cdot 342$ cm.^{2}/sec. The D values for C_6H_6/H_2 agree excellently, whether obtained by the Winkelmann or Wuppermann apparatus, the latter method proving the more accurate. The square-root rule did not hold for the two mixtures named above, whilst it was valid for C_6H_6/O_2 and C_6H_6/H_2. S. G. B.

2340. Impossibility of Complete Permanent Insulation with Solid Heat Insulator. Vernotte. *Comptes Rendus,* 192. *pp.* 340–341, *Feb.* 9, 1931.—Points out that the heat flow during non-steady régimes may be much greater than when the temperatures are stationary, and that solid insulators do not reduce losses arising in this way. J. H. A.

2341. Twenty-First Annual Exhibition of the Physical and Optical Societies. *Journ. Sci. Instruments,* 8. *pp.* 64–66, *Feb.,* 1931.—Notes on Exhibits: "Temperature Measuring Equipment," by **A. Ferguson**.

2342. Thermometer for Precision Calorimetry. T. C. Sutton. *Journ. Sci. Instruments,* 8. *pp.* 98–103, *March,* 1931.—A mercury-in-glass thermometer for sensitive calorimetric work has been developed by (i) reducing to 60 mm. the pressure of nitrogen in the space above the mercury column, and (ii) eliminating parallax by means of a novel and simple type of reading lens. AUTHOR.

2343. Precision Cryostat with Automatic Temperature Regulation. R. B. Scott and F. G. Brickwedde. *Bureau of Standards, J. of Research,* 6. *pp.* 401–410, *March,* 1931.—A cryostat has been designed and constructed for use in the temperature range from 0° to – 170° C. In this range the temperature can be easily adjusted to any desired value and can be automatically maintained constant to within 0·001° C. It can also be used for maintaining temperatures at the boiling points of liquid oxygen, nitrogen or air. The cryostat bath is contained in a double-walled cylindrical glass vessel surrounded by liquid air, the amount of refrigeration being controlled by varying the gas pressure between the walls. The cryostat liquid is circulated by a propeller in the bottom of a bakelite tube centrally located in the double-walled vessel. The liquid is pumped up the inside of the bakelite tube, which is the constant temperature region of the cryostat, and down on the outside. By operating the propeller through a system of gears driven by a shaft on the outside of the bakelite tube, the whole space inside is available for experimental apparatus. Constant temperature is automatically maintained by a photoelectric cell thermoregulator which controls the current through a heating coil wound on the outside of the bakelite tube. Adequate circulation of the liquid, suitable heat insulation and symmetrical distribution of the parts assure great uniformity of temperature. Non-inflammable mixtures of liquids are used for the cryostat bath between 0° and – 140° C. For lower temperatures liquid propane is used. AUTHORS.

2344. Automatic Constant Level Device for a Liquid Air Cryostat. R. B. Scott and F. G. Brickwedde. *Rev. Sci. Instruments,* 2. *pp.* 171–172, *March,* 1931.—An apparatus is described which will automatically maintain a constant level in a cryostat in which liquid air is used as the refrigerant. AUTHORS.

2345. Thermostat Regulator. E. Q. Adams. *Rev. Sci. Instruments,* 2. *pp.* 187–188, *March,* 1931.—A thermostat regulator has been constructed with a tungsten-mercury contact in hydrogen permanently enclosed in glass. Adjustment is made by a mercury-tight tungsten plunger in another 2 mm. capillary, one complete turn of the micrometer head advancing the plunger approximately 1 mm., equivalent to 0·08° C. The contact breaks approximately 1 mA which actuates relays controlling the heating circuit of 1 ampere, 110 volts, a.c. The regulator kept a 50-litre water thermostat constant to $\pm 0\cdot002°$ C. for an hour, with a 5-min. regulation cycle. With an auxiliary heater close to the regulator, the temperature variation was less than $\pm 0\cdot001°$ C. over a period of three hours and the regulation cycle less than 1 min. AUTHOR.

2346. Temperature of Maximum Density of Aqueous Solutions. Deviations from the Law of Despretz. (Miss) N. Gregg-Wilson and R. Wright. *J. Phys. Chem.* 35. *pp.* 624–628, *Feb.,* 1931.—The coefficients of expansion, and temperature of maximum density, are tabulated for a number of substances in concentrations from 1/8 *N* to 2 *N*. Despretz's law is found to hold only for dilute solutions. J. H. A.

2347. Expansion Hydrometer. E. Hiedemann. *Phys. Zeits.* 32. *pp.* 223–225, *March* 1, 1931.—The absolute expansion of liquids is usually measured by Dulong and Petit's method; for accurate results this requires very elaborate equipment, while with simplified apparatus errors amounting to 10 % may be introduced by convection currents, meniscus errors, etc. In the present method the liquid is contained in two U-tubes, one pair of ends of which are connected to a common source of high or low pressure and the other open to the atmosphere. The U-tubes are jacketed at two different temperatures. Two equivalent pressure-heads of liquid at known temperatures may therefore be read, by a cathetometer, under conditions in which meniscus errors are eliminated and convection currents are impossible. A negligible error is involved in the optical distortion introduced by the jacketing vessels. Single readings are accurate to ± 3 %, while an accuracy of ± 1 % is easily attainable from a series. L. V. C.

2348. Thermal Expansion of Alloys of Iron, Nickel and Cobalt, and the Cause of the Small Expansibility of Alloys of the Invar Type. H. Masumoto. *Tohoku Univ., Sci. Reports,* 20. *pp.* 140–177, *March,* 1931. *Report No.* 260 *from the Research Inst. for Iron, Steel and Other Metals.*—The mean coefficient of the thermal expansion between 30° and 100° in binary and ternary alloys of iron, nickel and cobalt, has been measured, and the relation between this coefficient and the equilibrium diagrams of these systems has been studied. Generally, the hexagonal solid solution has a greater and the α-solid solution a smaller coefficient of expansion than the γ-solid solution. Both the minimum at 18 % and the maximum at 25 % of nickel content found in the expansion coefficient-concentration curve of iron-nickel alloys becomes rapidly inconspicuous on the addition to them of cobalt. At the same time, the small coefficient of expansion of invar rapidly diminishes, reaches a minimum at about 5 % of cobalt, and afterwards increases, as the content of cobalt is increased. The measurement of the thermal expansion of alloys having small expansibility was made from the temperature of liquid air to the vicinity of the critical point, and the range of temperature available for this small expansibility was examined. The smallest coefficient of expansion found in the present investigation in the vicinity of room temperature was less than 10^{-7}. A theory is given by which the small expansibility of invar is satisfactorily explained without assuming the existence of a compound Fe_2Ni or the aid of the A_3 transformation. AUTHOR.

2349. Superheating and Intensive Drying of Liquids. E. Cohen and W. A. T. Cohen-de Meester. *Zeits. f. phys. Chem.* 153. *Abt. A.* 3–4. *pp.* 241–252, *March,* 1931. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 1003–1014, 1930. *In German.*—Experiments with water, benzene and CCl_4, both in flasks and in narrow tubes, indicate that when a heating bath is used, even with all the precautions noted by Smits, it is not possible under any conditions to obtain the true boiling point of the liquid; the degree of superheating observed is considerably greater than when a free flame is employed, and only by using an electrically heated wire immersed in the liquid is it possible to avoid superheating. The measurements of the boiling point of intensively dried liquids reported by Baker and by Smits must therefore be regarded as untrustworthy [see Lenher, Abstract 691 (1930)]. In reply to the above, **A. Smits** (*ibid.*, *pp.* 253–254, March, 1931) criticises both the manner in which the experiments were performed and the interpretation placed upon the previous results. [See also the two following Abstracts.] H. F. G.

2350. Superheating and Intensive Drying of Liquids. A. Smits. *K. Akad. Amsterdam, Proc.* 34. 2. *pp.* 268–270, 1931.—The author comments on this subject, referring to the work of E. Cohen and W. A. T. Cohen-de Meester [see preceding Abstract], having previously discussed the matter as arising out of Lenher's work [see Abstract 691 (1930)]. As early as 1923 he had arrived at the conclusion that boiling-point measurements were unreliable for investigating changes in constitution due to intensive drying, since the dried liquid might be prone to superheat. Thus he felt that Baker's results in 1928 were suspect, and he stresses the fact that Cohen's conclusion to the same effect is not new, and quotes his own words, written in 1928, to support this contention. J. H. A.

2351. Influence of Intensive Drying on the Establishment of Internal Equilibrium. Part I. A. Smits, E. L. Swart, P. Bruin and W. M. Mazee. *Zeits. f. phys. Chem.* 153. *Abt. A.* 3–4. *pp.* 255–261, *March,* 1931.—The elevation of the boiling point of liquids which is observed after intensive drying is ascribed to superheating, a result, probably, of the removal of dust from the liquid by the prolonged contact with the drying agent. The presence of dust may exert a catalytic influence on the establishment of the internal equilibrium of the liquid, although measurements with dust-free liquids do not afford any evidence of the abnormally low vapour pressure, resulting from surface evaporation, which would be anticipated on this view. One of the principal sources of error in distillation and vapour pressure experiments with dust-free liquids is the presence of gas in the liquid. No effect of intensive drying for 8 months has been observed with benzene which has been entirely freed from gases. [See also the two preceding Abstracts.] H. F. G.

2352. Vapour-Pressure Curves of Motor Spirits. P. Meyer. *Inst. Petroleum Technologists, J.* 17. *pp.* 42–68, *Jan.,* 1931.—Reference is made to the work of Ormandy and Craven, Brown and Ashworth among others. It is found that the air-free vapour-pressure curves for gasoline and motor spirits are all of the same type and that a single curve based on the Ramsay-Young boiling-point law accurately fits the data. Two methods of calculating the true vapour-pressure curve from the apparent vapour pressure curve are proposed. J. K.

2353. Vapour Pressures of Hydrocarbons. E. G. Linder. *J. Phys. Chem.* 35. *pp.* 531–535, *Feb.*, 1931.—The vapour pressure is measured by a modification of Ramsay and Young's method, for 39 hydrocarbons, in the region of 0° C. They are all small, from 0·01 to about 6 mm. of mercury. J. H. A.

2354. Vapour Pressures of Liquids. Part II. K. Watanabe. *Tokyo B.D., Sci. Reports,* 1. *pp.* 67–84, *Feb.* 25, 1931. *In English.*—The author derives a general equation for the vapour pressures of solutions which holds for gases, liquids and solids in any liquid solvent. The thermodynamic potential of a concentrated solution, the vapour pressure of a concentrated solution, Henry's constant, Margule's equation and the osmotic pressure of a concentrated solution are dealt with in succession. [See also Abstract 553 (1931).] H. H. Ho.

2355. Vapour Pressure and Heat of Dilution. Part VII. Vapour Pressures of Aqueous Solutions of Sodium Hydroxide and of Alcoholic Solutions of Calcium Chloride. A. M. Hayward and E. P. Perman. *Faraday Soc., Trans.* 27. *pp.* 59–69, *Feb.,* 1931.—The air-bubbling method has been employed for determining the vapour pressures over a wide range of concentration of: (*a*) Aqueous NaOH solution at 30°, 45°, 60°, 70° and 80° C. (*b*) Alcoholic $CaCl_2$ solution at 20°, 30°, 40°, 50° and 60° C., the densities being also measured. The heats of dilution were determined from the vapour pressure data by means of the Kirchhoff equation and of the modified Porter equation, and compared favourably with existing experimental data [see Abstract 1626 (1930)]. The osmotic pressures have also been calculated by use of the perfect gas law. Tables of these data are included in the paper. H. H. Ho.

2356. Extension of Ramsay and Young's Boiling-Point Rule. T. S. Wheeler. *Phil. Mag.* 11. *pp.* 441–449, *Feb.*, 1931.—If the vapour pressure p is connected with temperature T by a relation of the form $f(p) = a + b/\mathrm{T}$, and if $f(p)$ is such that $f(mp^n) = k_1 + k_2 f(p)$, a relation which holds when $f(p) = \log p$, then for any two pressures p_1 and p_2 such that $p_1 = mp_2^n$, the corresponding temperatures T_1 and T_2 are such that $a + b/\mathrm{T}_1 = k_1 + k_2(a + b/\mathrm{T}_2)$, or $1/\mathrm{T}_1$ and $1/\mathrm{T}_2$ are connected by a linear relation. Again, the vapour-pressure relation being given as before, but $f(p)$ now satisfying $f(mp) = k_1 + k_2 f(p)$, then for every two pressures p_1 and p_2 such that $p_1 = mp_2$, the corresponding temperatures T_1 and T_2 again satisfy a linear relation. A form of $f(p)$ in this case is that used in Bertrand's equation $p^q = a + b/\mathrm{T}$. These rules may be extended to pairs of liquids, provided the form of $f(p)$ is the same for both. Some uses of this rule in predicting properties of a substance by comparison with one which is better known are pointed out. J. H. A.

2357. Relation between Orthobaric Volumes and Temperature. J. Horiuti. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 286, *pp.* 89–104, *Feb.* 15, 1931. *In English.*—It is shown empirically that $\mathrm{RT}\log \mathrm{V} + \mathrm{A}/(\mathrm{V} - \mathrm{E})$ is the same for the liquid and the vapour state of a substance, and is further a linear function of temperature, where V is the molar orthobaric volume, T the absolute temperature, A and E are constants for the substance and R has its usual meaning. Extrapolating to absolute zero for the liquid, the volume there is found (again empirically) to be 1/3·4 of the critical volume, a relation which holds with some exactness. Again, the constant E is 0·169 times the critical volume, whilst A is related to the critical temperature and pressure. Yet another relation is that E is the sum of a number of quantities E^1, each appropriate to one of the elements composing a compound, the values of E^1 for all the elements in a chemical family being the successive multiples of a fundamental value for that family. J. H. A.

2358. Compressibility Isotherms of Methane. H. M. Kvalnes and V. L. Gaddy. *Am. Chem. Soc., J.* 53. *pp.* 394–399, *Feb.*, 1931.—The compressibility isotherms of methane have been determined to 1000 atmospheres at nine temperatures through the range − 70 to 200°. In the range of pressure and temperature duplicated, the results are in agreement with those of Keyes and Burks. With the exception of the pressure interval 500–1000 atmospheres at 100° the compressibility isotherms have considerable curvature. AUTHORS.

2359. Physical Constants of the System Methane-Hydrogen. F. A. Freeth and T. T. H. Verschoyle. *Roy. Soc., Proc.* 130. *pp.* 453–463, Feb. 3, 1931. Measurements have been conducted both on pure methane, prepared by two methods, and on the mixture. The isotherms at normal temperatures were measured to about 200 atmospheres by the method used previously [see Abstract 2643 (1926)]. The results for methane are expressed by giving the values of pv as a quartic function of pressure at 20° C. and as a sextic at 0° C., the accuracy being about 1 in 500. At both temperatures, the minimum pv occurs between 160 and 165 atmospheres, agreeing with Amagat's result. The vapour pressure (p) of solid methane is given in cm. of mercury from −182° to −208° C. by the equation $\text{Log } p = -517 \cdot 65/T + 6 \cdot 7843 - 0 \cdot 001425\ T$, where T is absolute temperature. The best value for the triple point is −182·40° C., 8·737 cm. mercury. The melting-point curve has also been measured to −181° C. J. H. A.

2360. Estimation of Specific Heats of Gases from the Vapour-Pressure Curve. M. Trautz and W. Badstübner. *Ann. d. Physik*, 8. 2. *pp.* 185–202, *Feb.* 4, 1931.—Using the known vapour pressure of a gas, the latent heat is determined from the Clapeyron equation, and by differentiation of the latent heat curve, its rate of change with temperature dL/dt is calculated. Now by another thermodynamic formula, $dL/dt = Sg - Se$, where Sg, Se are the specific heats of the gas and liquid at constant pressure. Thus if the latter quantity is known, the former may be calculated. A slightly less exact, but still useful, expression is $Sg = Se - 10$, since it is found that dL/dt has in general approximately this value. It is pointed out that this method is particularly useful for polyatomic gases, where other methods are most difficult. The agreement with experiment is illustrated by numerous tables. J. H. A.

2361. Additive Relations for Calculating Specific Heats of Gases. M. Trautz. *Ann. d. Physik*, 8. 3. *pp.* 267–285, *Feb.* 19, 1931.—It is found empirically that the quantity $(C_v - 3R/2)M^{2/3}$ may be expressed as the sum of a number of quantities k_r. Here C_v is the specific heat at constant volume, taken for a gm. molecule, and R is the gas constant, so that the numerator is that part of the molecular heat which is not due to the energy of translation of the molecules. M is the molecular weight. The quantities k_r are associated with the chemical bonds in the molecule, and they vary with the reduced temperature, so that the specific heat C_v may be predicted for a number of reduced temperatures, by using the appropriate values of the K_r. The actual temperature corresponding to this reduced temperature is, of course, known if the critical temperature of the compound is known, or if it can be estimated (*e.g.*, from the boiling-point). The quantities k_r seem to lie always between 0·1 and 0·5, and in the case where the value of the bond is unknown, an approximation to C_v may be made by assuming k_r between 0·15 and 0·2. J. H. A.

2362. Equation of a Perfect Gas and the Properties of Electrons and Protons. R. D. Kleeman. *Zeits. f. Elektrochem.* 37. *pp.* 77–80, *Feb.*, 1931.—Firstly considers the two kinds of equation of a perfect gas [see Abstract 2242 (1929)]. Two methods of treatment are then discussed for the interaction of molecules and radiation in equilibrium. A proof is given of the correctness of the equation, $p \,.\, v^{1+\alpha} = RT^{1+\beta}$, with respect to volume exponents. Finally discusses the properties of electrons and protons with respect to energy relations. H. H. Ho.

2363. Equation of State of Propellant Gases. A. D. Crow and W. E. Grimshaw. *Roy. Soc., Phil. Trans.* 230. *pp.* 39–73, *Feb.* 13, 1931.—The investigation extends the work of Petavel, and of Muraour and Burlot, to wider conditions, and leads to the formulation of an explicit expression for the equation of state of the gas resulting from the explosion of colloidal propellants. The procedure followed is to measure the pressures given by various propellants at different densities of loading (correcting for energy losses), and to compare values so obtained with those derived from the propellant compositions, using suitable kinetic and thermodynamical data. Numerous measurements are made in vessels of two different sizes, and time-pressure curves given by a special manometer designed by C. M. Balfour are recorded photographically. In these experiments the density of the gas complex approaches that of a light mineral oil, temperatures attain some 4000° K., and pressures 3800 kg./cm.^{2}. The spheres of action of the molecules are only slightly greater than the volumes of their electrical structures. Commencing with an equation of the Nobel-Abel type, $p_0 = \lambda \Big/ \left(\frac{1}{\Delta} - \eta\right)$, it is shown that the explicit equation of state of the propellant gas complex is

$$p_0 = \frac{84\cdot80\{\Sigma\text{gm. mols./gm.}\}T_0}{\frac{1}{\Delta} - 1\cdot092 \times 10^{25} \times \Sigma[(\tfrac{1}{2}\sigma_\infty)^3 g]},$$

where λ is the " ballistic force " of the propellant; η, the co-volume; Δ, the density of loading; $\frac{1}{2}\sigma_\infty$, the hard kernel molecular radius; T_0, the temperature of explosion. Agreement to within 2 % is established for λ between the experimental values and those obtained from thermodynamical considerations; and it is shown that the co-volume (η) can be evaluated from the constituents of the gas complex by using the hard kernel values of the molecular radii increased by some 2½ %. T. B.

2364. Reciprocal Relations in Irreversible Processes. Part I. L. Onsager. *Phys. Rev.* 37. *pp.* 405–426, *Feb.* 15, 1931.—Such irreversible processes as diffusion, heat conduction or electrical conduction, when allowed to occur simultaneously, interact with each other; the reciprocal relations studied are those between the various coefficients of the equations governing two phenomena concerned. They cannot be deduced entirely from classical thermodynamics, although several examples have long been known which were deduced by thermodynamic methods aided by some single assumption. In this paper such relations, in their generality, are deduced from the principle of microscopic reversibility. The method leads naturally to a generalisation of Lord Rayleigh's dissipation theorem.

J. H. A.

2365. Thermodynamic Investigations of Super-Cooled Phases. N. v. Raschevsky. *Zeits. f. Physik*, 67. 7–8. *pp*. 531–532, *Feb*. 6, 1931.—The author disagrees with the opinion of Schmolke [see Abstract 908 (1931)] that the notion of entropy is inapplicable for super-cooled phases, and discusses its correct use and signification in such a case. J. H. A.

2366. Classical Thermodynamics and Chemical Constants. A. Akopian. *Zeits. f. Physik*, 67. 11–12. *pp*. 851–859, *Feb*. 25, 1931.—It is shown that classical thermodynamics can lead not only to the Nernst relation, $J = \Sigma n_i J_i$, but also to a result, based upon the Nernst heat theorem, from which the idea of the chemical constant proceeds.

H. H. Ho.

2367. Van der Waals Forces in Gases. J. C. Slater and J. G. Kirkwood. *Phys. Rev.* 37. *pp*. 682–697, *March* 15, 1931.—A calculation of the van der Waals potential of two atoms at large separation has been carried out for hydrogen and helium. The method depends upon a representation of the perturbed wave function of the system as $\psi = \psi_0 (1 + vR)$, where ψ_0 is the unperturbed wave function, v the perturbing potential and R is a function of the radial coordinates of the electrons. The method is equally well adapted to the calculation of polarisabilities. A computation of the mutual energy of two hydrogen atoms confirms the results of Eisenschitz and London [see Abstract 2688 (1930)]. The polarisability of helium is calculated as $0{\cdot}210 \times 10^{-24}$ cc., which agrees well with the experimental value, $0{\cdot}205 \times 10^{-24}$. The mutual energy of two helium atoms is found to be $-3{\cdot}18\, E_0/(R/a_0)^6$. A correlation is obtained between the mutual energy of the two molecules ϵ and the polarisability α: $\epsilon = -1{\cdot}36 \nu_0^{1/2} a_0^{3/2} \alpha^{3/2} E_0/R^6$, where ν_0 is the number of electrons in the highest quantum state in the molecule, E_0 the energy of the hydrogen atom in the normal state, and R is the separation of the molecules. By means of this formula the van der Waals cohesive pressure constant is calculated for Ne, A, N_2 H_2, O_2, and CH_4. AUTHORS.

2368. Possible Energy Transformations according to Quantum Conditions. R. D. Kleeman. *Zeits. f. Physik*, 68. 3–4. *pp*. 286–288, *March* 20, 1931.—On the assumption that an electron or proton may possess a store of internal energy whose existence is not a result of electrical forces, the consequences are worked out for the following direct intertransformations of internal energy: potential electrical energy, radiating electromagnetic energy and kinetic energy. The seat of the internal energy is shown to be the field itself. Some of the present conclusions have already been derived by the author from thermodynamic considerations [see Abstract 2242 (1929)] of an electronic or protonic gas. H. H. Ho.

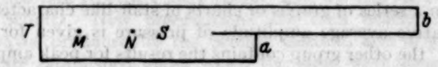
SOUND.

2369. Audition by Bone Conduction. C. E. Dean. *Acoustical Soc. of America, J.* 2. *pp.* 281–296, *Oct.,* 1930.—Audition resulting from vibration of the skull is investigated in various respects using audiometers with bone conduction receivers and other equipment. Applying the driving element at any point sets the entire skull into vibration, and the stimulus in one ear resulting from driving the skull on that mastoid is found to exceed the stimulus in the other ear by only 3·4 ± 2·2 db. The statistical accuracy of bone conduction observations is found and compared with published air conduction results. The sensitivity on the mastoid exceeds that on the forehead by 5 db on the average. Tests of instruments for measuring air conduction and bone conduction sensitivity to determine the amount of desired over undesired type of stimulation are described and the results given. The effect of a telephone receiver in producing hearing in the opposite ear is observed with two available cases of assured total deafness on one side and the data given. Beats involving bone conduction are observed. The fact that bone conduction sensations often seem in one ear is compared with similar results for air conduction stimuli under certain conditions, and a general statement of all results is made. The problems of apparent hyper-sensitivity resulting from abnormality and occlusion are discussed in the light of the foregoing results.

AUTHOR.

2370. Sounding Surfaces. E. Petzold. *Acoustical Soc. of America, J.* 2. *pp.* 305–308, *Oct.,* 1930.—All sources of sound are solid bodies which differ from one another in " surface loudness " or sound power per unit of area. The influence of this property on the sounds heard from musical instruments and on the acoustics of buildings is briefly outlined. G. E. A.

2371. Speed of Sound in Solids and Liquids. M. Reich and O. Stierstadt. *Phys. Zeits.* 32. *pp.* 124–130, *Feb.* 1, 1931.—Two microphones M and N are placed in the medium to be tested and are displaced relatively to the direction T, from which the sound comes.



Telephones connected with M and N are excited with a small time-difference, and produce a direction effect which is annulled by means of a compensator which adjusts the distances of the telephones from the ear. The material, solid, liquid or gas, is of the general form shown, the distance from *a* to *b* being $\lambda/4$ in order to avoid disturbance from reflected waves. In the gases CO_2 and H_2, and in the solids wood, lead and iron, the method gives results in satisfactory agreement with previous determinations. The change of speed when the substance is in the molten condition is such that the ratio, speed in solid/speed in liquid, is round about 2: 1 for ice, mercury, lead, cadmium and tin. Bismuth gave 0·83: 1. An analogous feature is pointed out in the thermal and electrical conductivities of metals. G. E. A.

2372. Supersonic Interferometers. E. Klein and W. D. Hershberger. *Phys. Rev.* 37. *pp.* 760–774, *March* 15, 1931.—The methods of applying h.f. sounds to small-scale measurements are discussed. An interferometer was constructed and used to measure the velocity of sound in gases, liquids and solids at frequencies ranging from about 10 to 700 kc. Three types of source were tried, *viz.*: quartz and Rochelle-salt crystals and magnetostrictive rods. The determination of the velocity of sound in solids is based upon: (1) optimum transmission of sound through a partition whose thickness is an integral number of half wave-lengths; (2) relative displacement of the nodal planes in a given liquid due to the immersion of a solid slab in the acoustical path. In the same manner, a small quantity of an unknown liquid is placed in a parallel walled cell and the latter is immersed in a liquid of known acoustic properties. Reactance and effective resistance of the interferometer (with a liquid medium) as a function of the reflector distance from the sound source were investigated. Approximate values of the impedance, power factor and watts dissipated in the instrument were thus computed. An improved circuit for use in absorption measurements in gases is described, as well as the extended use of the interferometer employing two identical sound generators. AUTHORS.

2373. Simple Theory of Acoustical Filters. E. J. Irons. *Journ. Sci. Instruments,* 8. *pp.* 89–93, *March,* 1931.—The paper gives an account of a simplified theory of acoustical filters which has regard to phase changes in the conduits. The calculated values of the "cut-off" frequencies for three filters are shown to be in very fair agreement with Stewart's experimental results [see Abstract 747 (1927)]. AUTHOR.

2374. Absolute Amplitudes and Spectra of Certain Musical Instruments and Orchestras. L. J. Sivian, H. K. Dunn and S. D. White. *Acoustical Soc. of America, J.* 2. *pp.* 330–371, *Jan.,* 1931.—Statistical data were obtained with regard to the output of musical instruments by means of apparatus which had been employed for similar measurements on speech [see Abstract 674 B (1930)]. Part of the apparatus consisted of fourteen band-pass filters designed to cover a total frequency range from 30 to 12,000. From observed voltages are calculated average and peak-pressure amplitudes. The instruments and combinations tested were: bass drums, snare drum, cymbals, triangle, bass viol, bass saxophone, bass tuba, trombone, trumpet, French horn, clarinet, flute, piccolo, piano, pipe organ and orchestras of 15, 18 and 75 elements. The results are set forth in a series of graphs or charts of stair-like character. In one group the relative average amplitude of pressure is given for each frequency range; the other group contains the results for peak amplitudes. G. E. A.

2375. Numerical Relations of Musical Scales. S. C. P. H. Hofbauer. *Pont. Accad. Sci., N. Lincei, Atti,* 84. *pp.* 30–32, *Dec.* 21, 1930.—Elaborates some further curious relations between musical intervals and the "golden section" [see Abstract 563 (1931)]. E. E. F. d'A.

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ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

2376. Electrostatic Fields. J. Labus. *Arch. f. Elektrot.* 25. *pp.* 17–20, *Jan.* 27, 1931.—A description of an experimental method of measuring electrostatic fields by means of arrangements with probes or test wires. J. J. S.

2377. Electrostatic Machines. F. Luscia. *Pont. Accad. Sci., N. Lincei, Atti,* 84. *pp.* 185–208, *Feb.* 15, 1931.—A preliminary account is given of the general mode of action of an electrostatic influence machine. It is shown that triboelectricity forms part of the theory of contact and it is proved experimentally that in it account must be taken of the diminution of capacity. Dispersion in the conductors is considered and its remedy by surrounding them with dielectric. In certain frictional and induction machines the case of the cushion functioning also as an inductor is discussed. The distribution of the signs of charge according to the Holtz-Righi phenomenon is analysed, and it is established that the cylinder machine does not show inversion of current at the diametral conductor. It is proved of what sign are the induced charges. The experiments of Musacus and of Schaffers with the inclined collector are recorded for proposing theoretical data for this collector and practical data for the diametral conductor. In the cylindrical machine the dissymmetry of the brushes increases the intensity and facilitates the auto-excitation. It is explained how the initial reversal of polarity lengthens the spark and why it may be useful to work with fixed polarity. It is found that usually it is not helpful to insulate the diametral conductor. In conclusion, it is shown when the putting to earth (as in the electrophorus) is effected. J. J. S.

2378. Capillary Waves Produced by Alternating Currents in Dielectric Liquids and their Application to Frequency Measurement. M. Katalinić. *Zeits. f. Physik,* 67. 7–8. *pp.* 533–555, *Feb.* 6, 1931.—In the introduction, the author discusses the differences which exist between his experiments on the electrically-produced oscillations of mercury drops [see Abstract 2614 (1930)] and the capillary-wave experiments of Schultz. New observations are then described concerning capillary waves produced by the Schultz method, and in particular the conditions are established under which the same wave frequency is produced by multiples of voltage frequency. The influence of secondary capillary disturbances at the meniscus is also investigated. The phenomena in petroleum and turpentine are also found to be unipolar. The precautions required for the use of the capillary wave method for frequency measurement are discussed. H. H. Ho.

2379. Development of Electricity in Quartz Crystals by Flexure. E. P. Tawil. *Comptes Rendus,* 192. *pp.* 274–277, *Feb.* 2, 1931.—Continues a previous investigation of electrical development by torsion [see Abstract 1615 (1929)], and describes the effects of flexure. Experimental details are given for flexure of the optical axis, of a binary axis and of an axis normal to the ternary and to the binary axes. In all three cases the signs of the electrical charges are reversed as soon as the force diminishes or when its direction is reversed. H. H. Ho.

2380. Temperature and Pressure Coefficients of Quartz Crystal Oscillators. S. L. Brown and S. Harris. *Rev. Sci. Instruments,* 2. *pp.* 180–183, *March,* 1931.—A method of measurement is used whereby variation in frequency of a h.f. oscillator can be measured easily to a fraction of a part in a million. The audible difference tone produced by a harmonic of a constant, h.f. oscillator and a harmonic of a second oscillator is compared to the tone of a variable, calibrated audio-frequency oscillator. Any change of the frequency of the second h.f. oscillator is measured to a fraction of a cycle per sec. This method of measurement is used to determine the effects of temperature and pressure on the frequency of a piezo-electric oscillator. The temperature effect is of the order of 20 parts per million per 1° C., while the pressure effect is of the order of only 6 parts per million per atmosphere. AUTHORS.

2381. Dielectric Constants and Electric Moments of Amines. P. N. Ghosh and T. P. Chatterjee. *Phys. Rev.* 37. *pp.* 427–428, *Feb.* 15, 1931.—By using a heterodyne null-beat arrangement, the electric moments have been calculated and the following results obtained:

methylamine, $A = 1\cdot37 \times 10^{-3}$, $\mu = 0\cdot99 \times 10^{-18}$;
dimethylamine, $A = 1\cdot22 \times 10^{-3}$; $\mu = 0\cdot90 \times 10^{-18}$;
trimethylamine, $A = 1\cdot19 \times 10^{-3}$; $\mu = 0\cdot82 \times 10^{-18}$;
ethylamine, $A = 2\cdot37 \times 10^{-3}$; $\mu = 0\cdot99 \times 10^{-18}$;
diethylamine, $A = 2\cdot59 \times 10^{-3}$; $\mu = 0\cdot90 \times 10^{-18}$; and
triethylamine, $A = 2\cdot90 \times 10^{-3}$; $\mu = 0\cdot82 \times 10^{-18}$. AUTHORS.

2382. Electric Moment and Molecular Structure. Parts I and II. C. P. Smyth, W. S. Walls and R. W. Dornte. *Am. Chem. Soc., J.* 53. *pp.* 527–539 *and* 545–555, *Feb.,* 1931.—Part I contains the measurements in benzene solution of the dielectric constants and densities of the ethyl esters of a number of mono- and dicarboxylic acids, which have been used, together with the refractions determined for the pure substances, to calculate the electric moments of the molecules. The ethyl esters of the monobasic fatty acids show a slight decrease in moment with increase in the size of the molecule analogous to the decrease in ionisation constant. Because of rotation around the bonds the relative positions of the — COOEt groups in the molecule do not have large effects upon the moment. The absence of marked difference in moment between the long and the short-chain esters is regarded as indicating that the long-chain molecules have extended structures, which do not bend appreciably in small external electric fields.

Part II similarly deals with the dielectric constants and densities of solutions of *tert*-butyl and triphenylmethyl chlorides and alcohols in heptane or benzene. The polarisations show that the branched carbon chain of the *tert*-butyl group has no measurably greater screening effect upon the force field of the dipole than the straight chain of the *n*-butyl group, while the larger triphenylmethyl group has a greater screening effect. A theory of induced moments has been applied to explain the values here obtained together with those of other investigators of alkyl halides. The moments do not show differences corresponding to the differences in chemical behaviour. H. H. Ho.

2383. Electric Moments of Organic Molecules. O. Hassel and E. Naeshagen. *Zeits. f. phys. Chem.* 12. *Abt. B.* 1–2. *pp.* 79–108, *Feb.*, 1931.—This paper continues a comprehensive investigation of the electric moments of organic molecules [see Abstract 2617 (1930)] and discusses experimental data concerning simple derivatives of *p*-dichlorobenzene, and symmetrical trichloro- and tribromobenzenes. The known " ortho effect," which is clearly recognisable in the disubstituted benzenes, is also present in these products, *e.g.*, 1:2:3:5-tetrachlorobenzene has a moment smaller than 0·65, whilst the moment of the simple chlorobenzene is 1·56. The importance of a knowledge of the electric moment of some higher substituted benzene derivatives for the derivation of the mutual positions of the substituents in compounds where ordinary chemical methods are applicable only with difficulty is discussed at length. H. H. Ho.

2384. Insulation of Pyrex Glass. J. H. Mitchell. *Phil. Mag.* 11. *pp.* 748–753, *March,* 1931.—Pyrex glass loses permanently much of its electrical insulating property after baking out in a vacuum. The conductivity rises from 50° to 80° C.; from 250° to 300° C. the conductivity remains somewhat greater on cooling; after heating from 350° to 400° C. there is a marked permanent increase in the conductivity after cooling. The conductivity very slowly approaches its original small value to a small extent when the specimen is allowed to stand in air; this does not occur when the specimen is immersed in liquid air; the former small conductivity is almost completely restored by a wash of hydrofluoric acid. A. D.

2385. Measurement of Atmospheric Electrical Conductivity. J. Scholz. *Phys. Zeits.* 32. *pp.* 130–139, *Feb.* 1, 1931.—Two forms of sensitive apparatus were set up at Potsdam, close to one another, to determine the electrical conductivity in such a way that meteorological conditions were eliminated. Comparative measurements indicated that it was expedient to determine the potential gradient by radioactive tests at considerable distances from the place of observation, for deviations amounting even to 100 % occur. With a wire network in front of the opening to the testing apparatus the positive conductivity is increased and the negative conductivity decreased. If an earthed network is below the opening the influence of the field is very great either with a raised or shielded tube. The same results are obtained by the charged and uncharged methods as well as by investigations on the influence of opposed fields at the edges of the condensers and measurements of conductivity with light and heavy carriers. These measurements are to be the object of a further paper R. S. R.

2386. Geographical Distribution of Magnetic Disturbance. W. F. Wallis. *Terr. Mag.* 36. *pp.* 15–22, *March,* 1931.—The magnetic results obtained by the two MacMillan Arctic expeditions of 1921–22 and 1923–24, and a comparison of these results with those from several other stations, indicate that during magnetic storms the greatest disturbance occurs in the region of the zone of maximum auroral frequency, and that there is a close correlation between the curves of magnetic activity and auroral frequency when both are plotted in relation to magnetic latitude. A study of the propagation of different types of magnetic disturbance indicates that all types are not propagated with the same velocity. Possible causes of terrestrial magnetic disturbances are discussed. AUTHOR.

2387. Effect of Sunspot Cycle on Magnetic Diurnal Variation at Apia. C. J. Westland. *Terr. Mag.* 36. *pp.* 6–8, *March,* 1931.—In this article the data used are the hourly values in magnetic declination, D, and horizontal intensity, H, each hourly value having been computed from the mean ordinate to the curve during the period of 60 min. commencing at the Greenwich hour stated. The difference between the highest and lowest hourly value in the day is called simply the " Range." Results of harmonic analyses are given, following the notation

$$\text{H or D} = m + r_1 \sin(\text{A}_1 + t) + r_2 \sin(\text{A}_2 + 2t) + \ldots$$

AUTHOR.

2388. Diurnal Variation of the Aurora Polaris. E. O. Hulburt. *Terr. Mag.* 36. *pp.* 23–28, *March*, 1931.—The auroral observations of the International Arctic Expedition of 1882–83, of the *Maud* Expedition, of three Antarctic expeditions and of temperate latitudes are assembled in order to bring out the diurnal variation of the aurora forms. Vegard's conclusion that the intense, moving and strongly coloured forms are more frequent in the evening than in the morning, the diffuse, weak and quiet forms being more abundant in the morning, appears to be valid. His conclusion that most auroral forms show an evening and a morning maximum is found to be contradicted almost as often as it is upheld. His conclusion that the hour of most frequent auroral occurrence falls near magnetic midnight is not found to be true at the Antarctic stations. On the whole the data give the impression that the diurnal course of an auroral display is different for the different stations, as if it depended upon the meteorology of the upper atmosphere of the station. AUTHOR.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

2389. Control of the Metallic Character of Pure Platinum Contacts. R. Holm and R. Störmer.—*Wiss. Veröff. a. d. Siemens-Konzern*, 9. 2. *pp.* 323–330, 1930.—The paper opens with a discussion of the ideal characteristics of metallic contacts and expressions are evolved for the calculation of the voltage/resistance factors of a metallic test piece with great precision. The expressions so developed are utilised for the experimental case of pure platinum, partially also with preheated platinum contacts. Contact measurements were also made upon pure platinum rods at high pressures. In the first case above, the experimental values agreed with the calculated figures within 1 %. At high pressures, platinum samples were used of which the Brinell hardness number was known, and a complete vindication was given of the formula $R = \rho/2A$, where R is the contact resistance, ρ the specific electric resistance and A the radius of contact or area of pressure. The results show that pure contacts at high pressures, as also preheated contacts, behave as pure metallic conductors and, furthermore, that Ohm's law is obeyed up to current densities of $4 \cdot 3 \times 10^6$ A/cm.^{2} for platinum and remains valid to within 1 %. S. G. B.

2390. Contact Conduction and Rectification. G. Hara. *Ryojun Coll. Eng., Mem.* 3. *No.* 4*a*. *pp.* 223–244, *Feb.*, 1931. *In English.*—Theories of conduction across surfaces in contact and their use for rectification have been propounded since the beginning of the century. Houston, using Sommerfeld's theory of metallic conduction, has built up a theory of cold electron emission. Here the theory has been carried still further to account for contact conduction, and to clear up its mechanism and also that of rectification. Diagrams are shown of both theoretical and experimental results. It is found that Ohm's law applies for metals when the distance apart of the contact is equal to that found for the lattice constant by X-rays. Also, in the case of partial conductors, their total current is equal to the sum of the currents passing across points of true contact and the conduction in minute gaps. The latter is comparable with the former, but may vary considerably, so non-linearity occurs in contact conduction of semi-conductors. Experiments on contact rectification are given involving two substances, *e.g.*, zincite and bornite, in contact. The results obtained are believed to show the existence of cold electron emission at contact. H. M. B.

2391. Influence of Thermal Treatment on the Characteristics of Copper Oxide Rectifiers. L. Dubar. *Comptes Rendus*, **192.** *pp.* 484–485, *Feb.* 23, 1931.—The thermal treatment to which a rectifier plate is subjected during fabrication as it determines the composition and structure of the oxide must have a great influence on the characteristics of this apparatus. The electrical properties of an element of a given useful surface may be defined by the current, in each of the two directions, corresponding to a given p.d. In the direction copper-oxide the current, always small, is little influenced by thermal treatment, but the current in the direction oxide-copper varies considerably according to the treatment. The treatments giving the best results are: (1) heating to 1000° C., slow cooling to 500°–600°, followed by a quick cooling, which with a p.d. of 4 volts gives a current of 4 to 8 amperes; and (2) heating to 1000° C., any cooling, prolonged re-heating in a furnace at 500°–600°, followed by quick cooling, which with the same p.d. gives a current of 5 to 10 amperes. The slow cooling from 1000° to 600° C. increases the proportion of CuO with oxide and consequently diminishes its resistance. The plate tested had a useful surface of 10 sq. cm. J. J. S.

2392. Passage of Direct Current through Acetone. G. Reboul and J. Sambussy. *Comptes Rendus*, 192. *pp.* 490–491, *Feb.* 23, 1931.—The variations in current observed by Carrigues [see Abstract 3901 (1930)] were not found by Lafond. The discrepancy is traced to the presence of light in the former case. They disappear in darkness, the current then diminishing regularly and exponentially with time, as found by Lafond. C. A. S.

2393. Relation between Conductivity and Temperature in Lead Chloride with Added Potassium Chloride. Z. Gyulai. *Zeits. f. Physik*, 67. 11–12. *pp.* 812–816, *Feb.* 25, 1931.—Pastilles were made of pure lead chloride, which was first melted, either in chlorine or nitrogen; in others KCl was added before the melting. They were heated in a glass tube, containing dry nitrogen, which was placed in a small electric oven. Wires were attached to the ends of the pastille, and the conductivity was found at different temperatures by measuring the current and the voltage required to produce it. The current through the pastille was constantly reversed during the measurement to avoid polarisation effects. Both the pure lead chloride pastilles, and those containing KCl, obeyed van't Hoff's formula $k = Ae^{-B/T}$, but the energy of separation, B, was considerably smaller for the mixture than for the pure lead chloride. For the pastilles formed of material melted in chlorine the mean values of A were three times as great for the mixture as for the pure substance, but for those melted in nitrogen the A values were practically the same for the pure and impure ones. The experiments of Seith show very large differences in the A values of the pure substance, due only to the mode of preparation; so that further measurements are necessary to decide what is the actual influence of the addition of KCl on the A values.

H. N. A.

2394. Temperature Dependence of Resistance of Ferromagnetic Metals. G. Borelius. *Ann. d. Physik,* 8. 3. *pp.* 261–266, *Feb.* 19, 1931. —Johansson has stated that the ferromagnetic metals exhibit normal behaviour at low temperatures, and that at higher temperatures with reduced magnetisation an additional resistance develops similar to the additional resistance of metallic mixed crystals. With the aid of a relation between resistance and spontaneous magnetisation, it is shown that the resistance of a ferromagnetic metal may be regarded as the sum of a normal temperature resistance, and an additional resistance which is related to the demagnetisation. G. E. A.

2395. Changes in Resistance of Nickel due to Magnetism and Hardness. S. R. Williams and R. A. Sanderson. *Phys. Rev.* 37. *pp.* 309–314, *Feb.* 1, 1931.—A series of 22 rods or strips of nickel, to which had been imparted different degrees of hardness by cold-rolling, had their resistance measured when subjected to a longitudinal magnetic field. There were eleven degrees of hardness, two samples for each degree. The longitudinal magnetic field increased the resistance in all cases. The different degrees of hardness did not vary the specific resistance of the nickel, but it did cause a large variation in the change of resistance due to a magnetic field. The measurements were carried out at a constant temperature of 35° C. AUTHORS.

2396. Change of Resistance of Pure Electrolytic Iron in Transverse Magnetic Fields. O. Stierstadt. *Zeits. f. Physik,* 67. 11–12. *pp.* 725–742, *Feb.* 25, 1931.—Electrolytic iron exhibits, in a transverse magnetic field, a smaller change of resistance than iron which contains impurities. The change at room temperature is of negative sign, and its relative amount is of the order 1:1000 at the threshold of magnetic saturation. The effect depends largely on the crystalline condition of the iron, and upon the directions of the axes of the separate crystals. A physical explanation of the effect is suggested. G. E. A.

2397. Magnetic Change of Resistance and Hall Effect in Cuprous Oxide with and without External Illumination. O. v. Auwers. *Wiss. Veröff. a. d. Siemens-Konzern,* 9. 2. *pp.* 294–299, 1930.—It is shown experimentally that the Hall effect for Cu_2O is very great, and the influence of light upon the Hall effect is relatively small. The alteration of resistance in a magnetic field is insignificant, but the influence of light upon the alteration in resistance is very great. The results obtained are discussed fully from the point of view of the uncertainty of the precise effect of the magnetic field, and also to elucidate the phenomena of the photoelectric effect in a semi-conductor. S. G. B.

2398. Resistance of Bismuth in Alternating Magnetic Fields. W. W. Macalpine. *Phys. Rev.* 37. *pp.* 624–633, *March* 1, 1931.—Apparatus for producing a field of 100 gauss r.m.s. at $10^6 \sim$ with a 50-watt tube is described. Also a method of measuring the behaviour of bismuth wire in such a field at liquid air temperature. For this purpose a potentiometer has been developed for the measurement of the amplitude and phase of voltages at frequencies up to at least $10^6 \sim$ per sec.

It was found that the resistance of the bismuth follows the instantaneous values of the field, having a magnitude at any instant equal to that which it would have if the field at that instant were maintained constant. The precision of the magnitude calculated from the various factors involved is ± 3·5 %, and the experimental value is normal within this precision. At 55 kilocycles and room temperature the resistance of the bismuth was also found to be normal in magnitude and phase. AUTHOR.

2399. Negative Potential Fall at the Anode. J. v. Issendorff. *Zeits. f. Physik*, 67. 7–8. *pp*. 556–566, *Feb*. 6, 1931.—Starting from the considerations which Langmuir [see Abstract 1003 (1928)] connected with the assumption of a negative anode fall in the mercury-vacuum arc, the author discusses the difficulties which arise for the comprehension of the mechanism of discharge in front of the anode. Langmuir's explanation is then replaced by one based on molecular statistics which takes into account the reversed motions of electrons due to reflection, and the loss by absorption at the walls under normal experimental conditions. H. H. Ho.

2400. Thermal Theory of Kathodic Disintegration. H. P. Waran. *Phil. Mag*. 11. *pp*. 397–404, *Feb*., 1931.—The thermal view advanced by the author to explain certain forms of disintegration observed in the glass walls of discharge-tubes is now extended to the case of the electrodes. Dealing with the sputtering of the kathode, the author has attempted an explanation of it as evaporation of small masses of metal under the localised intense heat of bombardment by the protons. Considering the sudden rise of temperature restricted to the immediate neighbourhood of the point of impact, it is found that the observed relative sputtering of metal is found to be explicable in terms of the thermal conductivity, density, boiling point, and other physical properties of the metal. AUTHOR.

2401. Distribution of Space-Potential in H.F. Glow Discharge. D. Banerji and R. Ganguli. *Phil. Mag*. 11. *pp*. 410–422, *Feb*., 1931.—The "exploring collector" method of Langmuir and Mott-Smith [see Abstract 764 (1927)] has been applied to study the space-potential distribution, ionic concentration, current density, and average electronic velocity in the case of h.f. discharge through rarefied air and oxygen. It has been found that the potential distribution is symmetrical about the middle point of the discharge tube, both the electrodes acting as kathodes in the corresponding d.c. discharge. The extension of the glow outside the electrodes is also a symmetrical reproduction of the phenomena inside, with the difference that after a certain length the potential becomes reduced to zero. AUTHORS.

2402. Sparking Potential and Sparking Constant in Hydrogen. E. Weichelt. *Phys. Zeits*. 32. *pp*. 182–183, *Feb*. 15, 1931. *Paper read before the Deut. Phys. Gesellsch., Dresden, Jan*., 1931.—Measurements of the sparking potential in pure hydrogen at room temperatures must be made at low pressures; for atmospheric pressure temperatures above 100° C. must be used. Measurements of the latter kind were made in specially designed apparatus, which is described in detail. Both a.c. and d.c. potentials were employed. All measurements were compared with the corresponding values for pure dry air. The ratio in the temperature region investigated, 115°–160° C., was found to be independent of temperature for gap widths from 0·5 to 3·2 cm. The mean value of the ratio was 1·166. The sparking constant could, however, only be roughly determined using Toepler's method of calculation, since the discharge system could not be accommodated in the heated chamber, and the long leads therefore necessary gave the circuit an appreciable self-induction. All that can be concluded from the results is that the sparking constant for hydrogen is certainly not greater than twice that of air, and is probably about 1·5 times greater. A. W.

2403. Coherence Length of the Light Emitted by Canal Rays. H. Straub. *Ann. d. Physik*, 8. 3. *pp*. 286–296, *Feb*. 19, 1931.—The author comments on E. Rupp's reply to his former criticism [see Abstract 1365 (1931)]. He criticises Rupp's apparatus with which he could see no interferences with the light of the canal ray itself, and considers that the observations and photographs of Rupp exhibit the interference of the luminosity at rest, and that with the apparatus it cannot be shown that Einstein's interferences were existent. In an answer to these remarks **E. Rupp** maintains the correctness of his own views. J. J. S.

2404. Relative Intensities of the Magnetic and Electrostatic Illumination Components in the Electrodeless Discharge. C. T. Knipp. *Phys. Rev*. 37. *pp*. 756–759, *March* 15, 1931.—Recent theory indicates that a considerable portion of the illumination in the electrodeless discharge is due to the electrostatic field. A discharge vessel was constructed to test this point experimentally. Obstructions were set in it with the idea that each type of discharge would cast its own shadow. Distinct shadows were obtained for both discharges when acting separately. When the magnetic field predominated and the ring discharge was fully formed no evidence was obtained of shadows due to electrostatic discharges, and conversely, as is shown by the photographs that accompany the article. The intensities of the two illuminations, as judged by the times of exposure, varied about as 1 to 50. The photographs seem to support the calculations of J. J. Thomson [see Abstract 702 (1928)].

AUTHOR.

2405. Motion of Electrons in Argon. H. B. Wahlin. *Phys. Rev*. 37. *pp*. 260–262, *Feb*. 1., 1931.—The motion of electrons in argon containing 1·53 % N_2 is investigated. For low fields the mobility is a constant, but rises rapidly as the field is increased due to the increase of the electron free path with increasing thermal velocity. The mean free path of electrons in pure argon and in thermal equilibrium with the argon is 0·385 cm. at 1 mm. pressure. [See also Abstract 3540 (1930).] AUTHOR.

2406. Cross-Section Measurements in Argon and Hydrogen for Very Slow Electrons. H. Gaertner. *Ann. d. Physik*, 8. 2. *pp*. 135–162, *Feb*. 4, 1931.—A method devised by Rusch is used to determine the effective cross-sections of argon atoms and hydrogen molecules with respect to electrons of velocities ranging from 0·2 to 6 volts. A stream of electrons of approximately uniform velocity is subjected to a magnetic field which acts in the direction of the stream. This longitudinal magnetic field causes the electrons to follow a helical path; the pitch of the helix depends on the intensity of the field and the velocity of the electrons. By means of an appropriate set of diaphragms spaced at equal distances it is possible to measure the electrons lost through collisions with gas atoms or molecules. The "two-cage" method of Ramsauer is used to determine the relative weakening of the electronic current after passing through the gas a distance equal to one and two turns of the helix. The *minimum* cross-section of argon was found to occur at an electronic velocity of 0·40 volt, which compares well with the value 0·39 first obtained by Townsend and Bailey (1922), and recently confirmed by Ramsauer and Kollath (0·37), whereas Rusch had obtained the value 0·70 volt for the minimum. For hydrogen the value of the *maximum* cross-section was found to occur at 2·5 volts, which agrees fairly well with a maximum of 3 volts obtained by Brüche when he used Ramsauer's magnetic method. This conflicts with the value 1·44 volts obtained by Townsend and Bailey for hydrogen. Rusch, however, also obtained the value 1·44 by a different method which did not involve the use of a magnetic field. This discrepancy in the values obtained by the different methods leads the author to suggest that a magnetic field, no matter in which direction it acts, has an influence on the curves giving the relation between cross-section and the corresponding velocities of the electron. H. L. B.

2407. Absorption Coefficient for Slow Electrons in Thallium Vapour. R. B. Brode. *Phys. Rev.* 37. *pp.* 570–573, *March* 1, 1931.—The absorption coefficient α has been observed by sending a beam of electrons through thallium vapour and measuring the decrease in intensity of the beam as a function of the pressure of the vapour. α, plotted as a function of the velocity of the electrons, decreases rapidly to a minimum of 15 at 1·4 volts, rises less rapidly to a maximum of 51 at 4·5 volts, and then slopes off gradually to 20 at 100 volts. AUTHOR.

2408. Scattering of Fast Electrons in Hydrogen as a Test of the Interaction Energy of Two Electrons. H. C. Wolfe. *Phys. Rev.* 37. *pp.* 591–601, *March* 1, 1931.—The electronic scattering of fast electrons is considered as a test of the formulæ for the interaction energy of two electrons. Three formulæ for the interaction energy of two Dirac electrons are considered: (i) the simple electrostatic interaction, (ii) the Gaunt formula, (iii) the Breit formula. The Dirac transition probability method is reviewed briefly. The cross-section of free electrons at rest for scattering fast electrons is calculated by the Dirac transition probability method, using each of the three formulæ for interaction energy. Random distribution of spins is assumed. Relativistic variation of mass with velocity is taken into account, removing the symmetry about 45° of the classical scattering formula. Expanded to terms in β^2 the formulæ obtained are compared with the classical Darwin formula and the recent formula of Mott. They differ from Mott's formula and from each other by terms of order β^2. For fast electrons, the scattering by hydrogen may be considered as the sum of nuclear and electronic scattering. A criterion for the validity of this procedure is obtained. The advantage of using hydrogen as the scatterer in experiments to test these formulæ is discussed. AUTHOR.

2409. Interference of Electrons by Reflection from Oil Surfaces. A. Bühl and E. Rupp. *Zeits. f. Physik*, 67. 9–10. *pp.* 572–581, *Feb.* 14, 1931.—100–400-volt electrons are reflected from oil surfaces, and well-defined, reproducible interference patterns are produced. The production of the interference can be described by means of Bragg's relation in terms of definite plane separations. These are as follows: tri-olein 12·3 Å., oleic acid 12 Å., paraffin oil 4 to 5 Å., valvoline (fresh surface)

8·72 Å., (old surface) 9·9 Å., veedol 9·9 Å., together with a second smaller separation 6 to 8·5 Å., Texaco oil 3·15 to 6·65 Å. The method seems suited to the examination of the surfaces of organic liquids, provided that the vapour pressure does not interfere with the electron reflection.

A. C. M.

2410. Effect of Water Vapour on the Mobilities of Negative Ions in Air. J. J. Nolan. *Roy. Irish Acad., Proc.* 39. *pp.* 82–99, *Dec.,* 1930.—The Rutherford-Franck alternating field method of measuring mobilities of ions is examined, and the effects of varying the auxiliary field and producing asymmetry in the alternating field considered. The method has been applied to the study of the variation in the character of the ionisation in air with change in the concentration of water vapour. Negative ions in moist air favour certain sizes of which there are always two or more present. The mobilities range from 1·5 to 2·4 cm./sec., the ions being the more mobile the lower is the concentration of water vapour. Ions of high mobility exist in air which has not been intensively dried. Mobilities of about 12 cm./sec. are observed for about 0·1 % of the ions formed in air containing a partial pressure of water vapour of 0·87 mm.

F. J. W.

2411. Dielectric Constant and Conductivity of Ionised Gases. T. V. Jonescu and C. Mihul. *Comptes Rendus,* 192. *pp.* 343–345, *Feb.* 9, 1931.—Measurements of the dielectric constant and the conductivity of an ionised gas by the method previously described by the authors [see Abstract 1647 (1931)] give values which are 30 times greater than those obtained by calculation. This can be explained by assuming that the electrons attach themselves to molecules and thus acquire a characteristic period of vibration which can be read off from the curves giving the experimental values, and which have the typical appearance of resonance curves. In the same way it is possible to explain the great range of short electric waves having wave-lengths ranging from 10 to 40 m., if it be assumed that the upper atmosphere contains molecules to which electrons have become attached and so have acquired a characteristic period of vibration. Calculations of the reflective power of an ionised layer of this kind show that it is very great for the waves whose lengths lie between 10 and 40 m. H. L. B.

2412. Ionisation of Argon, Neon and Helium by Alkali Ions. R. M. Sutton and J. C. Mouzon. *Phys. Rev.* 37. *pp.* 379–382, *Feb.* 15, 1931.—Cæsium, rubidium, potassium and sodium positive ions from Kunsman catalyst sources, and lithium ions from spodumene have been used to produce ionisation in helium, neon and argon. In most cases the ionisation sets in between 100–150 volts and increases linearly to 750 volts, the highest potential used. Maximum ionisation was produced in each gas by the alkali ion closest to it in atomic number. AUTHORS.

2413. Production of an Intense Beam of Positive Hydrogen Ions. L. R. Maxwell. *Rev. Sci. Instruments,* 2. *pp.* 129–140, *Feb.,* 1931.—An intense beam of positive hydrogen ions is obtained by diminishing the loss of ions to the walls of the discharge tube. This is accomplished by placing the discharge chamber in a strong magnetic field in which the direction of the magnetic field is parallel to the direction of motion of the positive ions. The magnetic field provides an external force which keeps the ions in a beam of small cross-sectional area so that a large number of them can pass through the canal. By means of the apparatus described it is possible to produce a positive hydrogen ion beam corresponding to currents of amounts ranging up to 3 mA in a region of pressure of $3 \cdot 3 \times 10^{-3}$ mm. of mercury. H. L. B.

2414. Capture of Electrons by Positive Ions. J. L. Destouches. *Comptes Rendus*, 192. *pp*. 345–348, *Feb*. 9, 1931.—In a previous paper [see Abstract 1653 (1931)] the author has shown that discontinuities occur in the curves giving the effective cross-section for recombination at points which can be related to the energies corresponding to various Bohr levels. The author affirms that, contrary to the opinion expressed by Rutherford, the phenomenon remains the same no matter what the relative velocities of the ions and electrons happen to be. The formula which gives the effective cross-section for recombination presents discontinuities at points which cannot, however, be exhibited directly, as Davis and Barnes believe, owing to the electronic density that is required being too great. The formula renders it possible to interpret the experiments of Henderson and Rutherford on the capture of electrons by α-particles and shows that this cannot take place except at the end of the free paths, when the velocity of the ions is less than $4 \cdot 4.10^8$ cm./sec. with respect to the electrons. H. L. B.

2415. Release of Electrons by the Collision of Positive Ions at Low Gas Pressures. Part II. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 68. 3–4. *pp*. 162–173, *March* 20, 1931.—The method described in Part I [see Abstract 3818 (1930)] has been extended and at the same time subjected to tests which have proved its utility. The following results have been established: (1) In the case of H_2 and N_2 the output (*Ausbeute*) of electrons by the collisions shows a marked rise as the layer of gas on the kathode increases, while there is no such connection in the case of the inert gases. (2) Above 1000 volts the output increases only slightly with the energy of the positive ions. (3) The number of ions released by a colliding ion is considerably less at 3000 volts than the number of atoms " sputtered " by the kathode. (4) In general (but not always) it is the greater the less the mass of the impinging ion. (5) It has not been possible to discern a connection between the output and the work of escape of the electrons. For example, the output in the case of Ag and Al is equally great and in the case of K and Na is not much greater than in the case of Ag and Al. H. L. B.

2416. Positive Ion Emission from Thin Platinum Films on Glass. R. A. Nelson. *Rev. Sci. Instruments*, 2. *pp*. 173–179, *March*, 1931.—An apparatus is described for the production of positive ions of certain alkali metals, in particular, potassium, from an equipotential surface. A means of controlling the thermionic activity of the surface is provided. It is definitely established that the positive ion current from platinised glass is greater than from unplatinised glass at the same temperature. A new effect, the existence of a maximum and minimum, observed to a slight degree in the glass filaments, is found to be very pronounced when using this new type of equipotential emitter. A qualitative explanation of the observed phenomena is offered, based on the work of Langmuir and Kingdon, Brewer and Becker. AUTHOR.

2417. Theory of the Internal Action of Thermionic Systems at Moderately High Frequencies. Part II. W. E. Benham. *Phil. Mag.* 11. *pp*. 457–517, *Feb*., 1931. *Supplement*.—A mathematical paper in which the theory outlined in Part I [see Abstract 1691 (1928)] is developed and an analysis is given of the " first-order " solution. The theory is subject to the following assumptions: (1) The propagation of electromagnetic waves across the space takes place in a time which is small compared with the time period of the potential and time of transit of the electrons. (2) The alternating potential is small compared with the steady potential existing between the plates. (3) The steady state distribution is that for which initial velocities are neglected. The theory is used to replace the thermionic system, as far as its first order a.c. properties are concerned, by an equivalent circuit which is defined as follows: An electrical network which, when used to replace the thermionic system, gives results which are indistinguishable from those given by the thermionic system by measurements in any associated circuit. Considerable space is devoted to the subject of the dielectric constant of space charge, and experiments are quoted which support the theoretical conclusions. The space-charge case is compared and contrasted with the case of a layer of electrons in loose association with positive ions. An outline of the cylindrical case is given. J. J. S.

2418. Oxygen Films on Tungsten. I. Langmuir and D. S. Villars. *Am. Chem. Soc., J.* 53. *pp.* 488–497, *Feb.*, 1931.—A method is presented of studying the rate of loss of oxygen from an adsorbed film on tungsten, as well as of detecting its presence in a gas. This consists in observing its effect on the electron emission of a tungsten filament, sensitised by the presence of minute traces of cæsium vapour (10^{-6} mm.). Under properly chosen conditions a monatomic oxygen film makes its presence known by increasing the emission a millionfold. Using this method, the heat of evaporation of oxygen from the adsorbed layer was found to be 162 kg. cal. (7·0 V) per gm. atom. [See also Abstract 1182 (1925).] E. E. F. d'A.

2419. Space Charge versus Image Force in Thermionic Emission. R. S. Bartlett and A. T. Waterman. *Phys. Rev.* 37. *pp.* 279–282, *Feb.* 1, 1931.—This paper is a joint report on work by the two authors, preliminary to further and more detailed publication on different phases of the problems here discussed. Attention is called to certain deficiencies in the Schottky image force as an explanation of the thermionic work function, both on theoretical and experimental grounds. Evidence is advanced to show that space charge is more important than image force over most of the region in which the image force is thought to be valid. It is further shown that space charge with Fermi-Dirac statistics is able to account for observed phenomena of thermionic emission, including the effect of external fields. Numerical examples indicate some of the consequences of this point of view. AUTHORS.

2420. Cold Emission from Unconditioned Surfaces. W. H. Bennett. *Phys. Rev.* 37. *pp.* 582–590, *March* 1, 1931.—The greatest difficulty in obtaining higher potentials in tubes is due to auto-electronic emission from the electrode surfaces. A study of emission from unconditioned metals is described leading to the result that either loose fine particles in a tube, or else the targets of emission, will probably have more to do with the quantity of emission than will the kind and " conditioning " of the kathode itself. AUTHOR.

2421. Sensitive Light Counter. B. Rajewsky. *Phys. Zeits.* 32. *pp.* 121–124, *Feb.* 1, 1931.—Modifies a Geiger-Müller counting tube by lining it with photoelectric substances and counting the number of deflections per second it produces in a string electrometer for a given light intensity. Gets down to a flux of $9 \cdot 1 \times 10^{-11}$ erg/cm.^{2} sec., which represents about 12 quanta per cm.^{2} sec. E. E. F. d'A.

2422. Sensitising Potassium. W. Kluge. *Zeits. f. Physik*, 67. 7–8. *pp.* 497–506, *Feb.* 6, 1931.—The selective photoelectric emission of potassium is increased by exposure to the vapours of sulphur, selenium, or tellurium. For each substance there exists an optimum thickness of the sensitising substance, beyond which any further deposit reduces the emission. The maximum is shifted to 410 mμ by sulphur, 425 mμ by selenium, and 430 mμ by tellurium, selenium having the strongest action. E. E. F. d'A.

2423. Amplification of Small Direct Currents. L. A. DuBridge. *Phys. Rev.* 37. *pp.* 392–400, *Feb.* 15, 1931.—A new type of thermionic valve, recently described by Metcalf and Thompson [see Abstract 577 B (1931)], has made it possible for the first time to construct d.c. amplifying circuits with a current sensitivity exceeding that of any form of electrometer except the Hoffman, and with a ruggedness and dependability unattainable with any form of sensitive electrometer. The circuits are easily constructed and simple to operate. Three types of circuits have been tested out and are described. (1) A simple single-valve circuit with a Leeds and Northrup Type R galvanometer has been found satisfactory for measurements of currents as small as 10^{-14} ampere. (2) A two-valve bridge circuit gives greater stability and will easily measure currents of 10^{-16} ampere. It has been found capable of detecting currents of 5×10^{-18} ampere. (3) A two-stage circuit, using one of the new valves and one of the UX-112A type, will amplify currents of 10^{-14} ampere to such a value that they may be read on a microammeter. AUTHOR.

2424. Amplification of Photoelectric Currents. H. Simon. *E.T.Z.*, 52. *pp.* 264–266, *Feb.* 26, 1931.—Owing to the smallness of the current from photoelectric cells, it is necessary to use amplifiers. Several types are described, suitable for different purposes. E. E. F. d'A.

2425. Amplification of Photoelectric Currents. P. Lejay. *Comptes Rendus*, 192. *pp.* 551–553, *March* 2, 1931.—Describes the use of modern triode valves with an electrometer. It is possible to adjust the circuit of five valves in such a fashion that the last valve works on the straight-line portion of its characteristic. The light of Jupiter without an objective gives 30 mA per second, enough to work an ink recorder. E. E. F. d'A.

2426. Characteristic Surfaces of Photoelectric Cells. G. A. Boutry. *Comptes Rendus*, 192. *pp.* 411–413, *Feb.* 16, 1931.—Constructs the characteristic surfaces $i = f$ (F, V) of photoelectric cells, exhibiting the relation between current i, light flux F and voltage V. On these surfaces the author distinguishes six regions. The cells are not of the vacuum type. E. E. F. d'A.

2427. Formation of Photographic Images on Kathodes of Alkali Metal Photoelectric Cells. A. R. Olpin and G. R. Stilwell. *J.O.S.A.* 21. *pp.* 177–181, *March*, 1931.—A method of forming both negative and positive photographic images on the kathodes of potassium and sodium photoelectric cells in vacuum is described. These images are sharp and clear in every detail and can be permanently "fixed" by proper treatment. Among the materials which have been successfully used in treating the exposed surfaces to bring out these images are sulphur vapour, air, oxygen and hydrogen in the ratio of 9 to 1, hydrofluoric acid and bromine. During the time the image is forming, the photoelectric sensitivity of the illuminated portions decreases approximately 30 %. After the image is fixed as a permanent record there is little difference between the sensitivity of the kathode area bearing the image and neighbouring areas. Photographs of photoelectric cells are shown in which such photographic images are plainly visible. [See also Abstract 4099 (1930).] AUTHORS.

2428. Photoelectric Behaviour of Salts. J. Klaphecke. *Zeits. f. Physik*, 67. 7–8. *pp.* 478–496, *Feb.* 6, 1931.—Continues Werner's work on the Hallwachs effect in salts [see Abstract 318 (1930)]. Werner employed, almost exclusively, sublimed or well-dried salts, with comparatively very few "loose spots" in their structure. The author has also used salts crystallised out of their solutions, which contain many included water molecules so that the number of "loose spots" is large. It is shown that this considerably affects their behaviour. It is also shown that, when light of long wave-length acts on salts which have previously been exposed to light of short wave-length, results are obtained which are parallel to the phenomena of the interior photoelectric effect of Gudden and Pohl. H. N. A.

2429. Theory of the Regressive Effect of the Photoelectric Limiting Potential. E. Marx and A. E. H. Meyer. *Phys. Zeits.* 32. *pp.* 153–163, *Feb.* 15, 1931.—It has been shown [see Abstract 3543 (1930)] that if two monochromatic beams fall simultaneously on a metallic electrode and if the intensity of the light of higher frequency is sufficient to establish the limiting potential corresponding to the Einstein law, the presence of the beam of lower frequency diminishes the potential in accordance with a definite formula. A detailed explanation of this phenomenon is given. The mathematical theory, which is based on classical electrostatics, shows that the following laws hold: (1) Every space charge must cause an increase in the work of escape. Hence the measured limiting potential must always be smaller when a space charge is present than when it is absent. (2) For different monochromatic frequencies the limiting potential is not a function of the space charge in the apparatus. (3) When radiation of lower frequency is allowed to fall on the metal electrode which has established its limiting potential for the light of higher frequency a new space charge becomes added and a potential decrease occurs in accordance with the formula mentioned above. (4) The electrons which are liberated in the metal arrive at the surface from greater depths than that to which the charge penetrates. The bearing of the theory on photochemical and other phenomena is also discussed. H. L. B.

2430. Photoelectric Effect and Electron Diffraction at Potassium Surfaces Treated with Hydrogen. W. Kluge and E. Rupp. *Phys. Zeits.* 32. *pp.* 163–172, *Feb.* 15, 1931.—A method is described for measuring the photoelectric emission from a potassium layer and at the same time for investigating the nature of the layer by means of reflected electrons which give interference patterns. Pure potassium was investigated, and also potassium exposed to hydrogen and potassium affected by a glow discharge in hydrogen. The structural investigations gave a value of 7·3 volts for the mean inner potential of the potassium and a value of 5·4 Å. for the lattice constant of potassium hydride; this has not yet been measured by X-rays. The relation between the selective photoelectric effect and the diffraction maxima for the different types of surfaces is exhibited in a table. The results appear to support Pohl's view, according to which the selective photoelectric effect is due to atomically or molecularly distributed potassium particles embedded in the potassium hydride, the amount of the effect depending on the size of the particles. H. L. B.

2431. Treatment of the Photoelectric Effect by the Relativistic Wave Equation of Dirac. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 288. *pp.* 111–126, *Feb.* 28, 1931. *In English.*—The photoelectric effect is discussed in outline, making use of the ordinary perturbation theory of Dirac's *linear* wave equation instead of the second order one used by Szczeniowski [see Abstract 2648 (1930)], and the results of both methods are shown to agree within a first approximation. AUTHOR.

2432. Theory of the Photoelectric Effect in Metals. I. Tamm and S. Schubin. *Zeits. f. Physik,* 68. 1–2. *pp.* 97–113, *March* 11, 1931.—The authors' results are similar to those obtained recently by H. Fröhlich, and the present paper deals, mainly in connection with the surface effect, with points with which Fröhlich has not fully dealt, or with regard to which there is a difference of opinion with him. In a space free of field there is no photoelectric effect on the free electrons. Photoelectric emission in metals, and absorption of light in general, are made possible by the jump in potential at the boundary vacuum-metal (the surface effect), and by the fact that the potential varies periodically in the interior of the metal, so that the conductivity electrons tend sometimes to unite with the atoms (volume effect). The photoelectric effect depends almost entirely on the surface effect, which has relatively small influence on the absorption of light in the ordinary sense. The output of photoelectrons, the position of the maximum output, and the relation with the polarisation of the light, found by the theory all agree well with experiment. The volume effect is only concerned with the emission of electrons when a "second long wave-length limit" of the frequency ν_g' has been passed. This frequency can be estimated by means of Bloch's theory, and is much greater than the limiting frequency ν_g of the surface effect. It produces a second rise in the output curve at $\mu > \nu_g'$. The influence of collisions of the electrons with the metallic lattice, the effect of foreign surface layers, and that of temperature are briefly dealt with. H. N. A.

2433. Oscillations in Discharge Tubes and Allied Phenomena. J. J. Thomson. *Phil. Mag.* 11. *pp.* 697–735, *March,* 1931.—Investigates theoretically and practically the behaviour of an ionised gas in a discharge tube. The electrons oscillate with a high frequency, producing a.c. even when the applied voltage is constant. Under certain conditions the discharge through the positive column, whether it is striated or continuous, becomes intermittent. The following types of vibration are shown theoretically to be possible: (1) Vibrations of the electrons themselves, depending only on the number of electrons per unit volume. These vibrations are not affected when a condenser is connected up with the tube. (2) Vibrations of the positive ions, which are similar in character to (1), but have smaller frequency; they occur only when the number of positive ions is greatly in excess of that of the electrons, as in the Crookes dark space. (3) A series of explosions following one another at regular intervals, the intermittent neon lamp being an example. Affected greatly by connecting a condenser with the tube. (4) Discontinuous discharge along the positive column in a succession of pulses, the interval between them depending on the rate at which the electrons diffuse from the negative glow into the positive column. They differ from (3) in not being affected by a condenser. In types (1) and (2) the current changes in direction, in (3) and (4) it is intermittent, but always in one direction. The discharge in a narrow tube was examined by means of a rapidly rotating mirror; the appearance was much like a spectrum, which was made up of three kinds of lines α, β and γ. The α lines, which correspond to type (3) above, occur when the pressure and current are such that dE/di is negative. E is the e.m.f. and i the current. The β lines seem to correspond to type (4), and are much nearer together than the α lines. The γ lines are always close to the α lines, and are very close together, *i.e.*, they represent vibrations of great frequency. They seem to be of type (1), and are due to the vibrations of ionised gas excited by explosions of type (3). In addition to these there is a so-called throbbing effect, where the discharge passes for a time, stops after an interval (up to a minute), begins again, and sometimes goes on doing this for half an hour or more. H. N. A.

2434. Oscillations and Travelling Striations in an Argon Discharge Tube. T. C. Chow. *Phys. Rev.* 37. *pp.* 574–581, *March* 1, 1931.—The effects of current and external circuit conditions on the frequency of travelling striations were observed. Some information concerning the voltage fluctuations at different parts of the tube was obtained. Electron temperatures in the positive column were determined at different pressures. A set of wave-lengths bearing simple relations with the length of the tube were calculated by means of Tonks' and Langmuir's theory of electric sound waves and the experimental values of the flash frequency. [See Abstract 1637 (1929).] AUTHOR.

2435. Effect of a Magnetic Field on the Long-Wave Radiation from the Electric Spark. M. A. Lewitsky. *Phys. Zeits.* 32. *pp.* 252–255, *March* 15, 1931.—The author describes theoretical and experimental evidence for the creation of such radiation, attributing them to the individual vibrations of the metallic particles or their overtones. Other forms of radiation are reviewed in the light of the explanations suggested. S. G. B.

2436. Mechanical Distortion of a Wire by Electrical Discharge. O. Bethge. *Ann. d. Physik,* 8. 4. *pp.* 475–499, *March* 26, 1931.—If a thin platinum wire is put into a circuit with a condenser and spark gap, and a discharge sent through the circuit, the wire glows momentarily. On cooling, it appears distorted into a wave-form. For repeated spark discharges, the amplitude of the wave increases and finally the wire breaks. The break does not occur if the wire can yield to the stretching force. This phenomenon can be accounted for qualitatively if we suppose that the sudden heating of a wire does not allow time for full expansion and so a great variation of pressure is set up, and this causes deformation. A theory based on that of Kaufmann is elaborated and an experimental arrangement for producing the distortion and examining it optically is described. Results are obtained which give a wave-length only about one-third of that predicted by theory. An example of an effect noticed by Humphreys in 1915 in connection with lightning conductors is discussed from the point of view of the theory given. H. M. B.

2437. Paramagnetism of Polychromates. F. W. Gray and J. Dakers. *Phil. Mag.* 11. *pp.* 297–314, *Feb.*, 1931.—The anomalous low paramagnetism of the compounds of hexavalent chromium, of heptavalent manganese, and of trivalent ruthenium, rhodium, tungsten and iridium presents an important problem in magneto-chemistry. In all these cases the seat of the paramagnetism is usually considered to be the element mentioned, and the atomic paramagnetism of the element in question is obtained by calculating the paramagnetic molecular susceptibility of its compound, and correcting this for the diamagnetic susceptibility of the constituent atoms. The results hitherto have been too low to reconcile with theory. Whatever view of molecular structure is adopted, it is always necessary to apply a diamagnetic correction to the experimental value of the paramagnetism in order to obtain the true paramagnetism. In making this correction the authors have used the diamagnetic atomic values of Pauling for certain ions, together with the interpolated values given by Gray and Farquharson for other ions. Various selections of ions have been tried in order to interpret experimental results. Three special structures are discussed as being of prime interest. In the first case the constituent ions are regarded as being Cr^{+6}, O^{-2}, K^{+1} and Na^{+1}, the proportion being such as to maintain the molecule neutral. In these structures all the electrons are subatomic, hence all the diamagnetism applicable as a correction is therefore subatomic. In the second case the ions utilised are Cr^{+6}, O^{+2}, K^{+1} and Na^{+1}. In this structure for neutral molecules, electrons are required in addition to those going to form the ions. The correction diamagnetism here, is of two parts namely, that derived from subatomic electrons, and that due to the interatomic or surplus electrons which may be regarded as forming valency bonds. In the third case the structures are considered as being of the type used by Gray and Farquharson in their study of halogenates and perhalogenates, where an interchange of electrons with consequent fluctuation of angular momentum would cause a small paramagnetism to a greater extent in the more homopolar bonds, and to a lesser degree in the more heteropolar. This method provides the best interpretation and agreement with experimental results. Discussion of these three aspects and experimental details are given fully. S. G. B.

2438. Temperature Dependence of the Relative Concentration of he Paramagnetic and Diamagnetic Molecules in Nitric Oxide. E. Brody, T. Millner and R. Schmid. *Zeits f. Physik*, 68. 5–6. *pp.* 395–402, *March* 24, 1931.—On the basis of band-spectra knowledge it is found that the fundamental term or condition of the NO molecule is a $^2\Pi$ condition with a doublet separation of 120·5 cm.$^{-1}$ (corresponding to 343 cal./mol. energy difference). At room temperature, therefore, in NO both types of molecule are approximately at equal concentrations, but at low temperatures, on the contrary, the diamagnetic molecules predominate. The relative concentration ratio of both types of NO molecules at different temperatures is investigated in the present paper, from the data furnished by the absorption band $\gamma(0\cdot0)$ and is found to be in good agreement with calculated values. S. G. B.

2439. Magnetic Susceptibilities and Ionic Moments in the Palladium and Platinum Groups. A. N. Guthrie and L. T. Bourland. *Phys. Rev.* 37. *pp.* 303–308, *Feb.* 1, 1931.—Susceptibility measurements have been made on Ru, Rh, Pd, Os, Ir and Pt and some of their compounds over a range of temperatures by means of an improved Curie balance. Pd and Pt are found to follow approximately a Curie-Weiss law. Ru, Rh, Os and Ir are found to have paramagnetic susceptibilities which increase with temperature. $RuCl_3$ and IrO_2 are found to follow a Curie-Weiss law which gives for the ion Ru^3 a moment of 9·8 Weiss magnetons per mole and for Ir^4 13·8. The spectroscopically predicted value for each ion is 29·4. The paramagnetic susceptibility of Rh_2O_3 is found independent of temperature, while that of RuO_2 increases rapidly with temperature. $RhCl_3$ is found to have an unmeasurably small susceptibility over the temperature range investigated. $IrCl_3$ and $PtCl_2$ are diamagnetic with susceptibilities independent of temperature. AUTHORS.

2440. Strain and Diamagnetic Susceptibility. H. E. Banta. *Phys. Rev.* 37. *pp.* 634–635, *March* 1, 1931.—The magnetic susceptibility of copper and silver wires has been measured by the Gouy method before and after various annealing processes. Also, the susceptibility has been measured before and after straining specimens beyond the elastic limit, the strains being either twists or stretches. The susceptibilities are found to be increased by as much as 20 % for copper and 3 % for silver by annealing at red heat for 15 min. in an atmosphere of CO_2. This increase is probably due to release of occluded gases or to oxidation or recombination of impurities. Straining the specimens beyond the elastic limit is found to produce no measurable change of susceptibility. Bitter has observed a large effect due to straining these metals beyond the elastic limit [see Abstract 988 (1931)]. The reason for Bitter's results is not clear, but it is pointed out that no effect is to be expected in copper, at least, because crystals of this metal are isotropic magnetically and have no observable magnetostriction. AUTHOR.

2441. Charge Distribution and Diamagnetic Susceptibility of Atoms and Ions. G. W. Brindley. *Phil. Mag.* 11. *pp.* 786–792. *March,* 1931.—The diamagnetic susceptibilities calculated by Pauling [see Abstract 1622 (1927)] for hydrogen-like atoms and by Stoner [see Abstract 338 (1930)] using Hartree's distributions of charge are generally larger than experimental values. Slater [see Abstract 3938 (1930)] has given a method for calculating approximate wave-functions which yields susceptibilities in much better agreement with experiment. The deduction of ionic susceptibilities from measurements made on salts is briefly considered. AUTHOR.

2442. Theory of Magnetisation Curves of Monocrystals. N. S. Akulov. *Zeits. f. Physik,* 67. 11–12. *pp.* 794–807, *Feb.* 25, 1931.—In previous papers the author has propounded a theory of ferromagnetism, in which he assumes that reversal of magnetism may take place in two ways. In the first the magnetisation vector of the single elementary regions retains its direction, but alters its absolute value from positive values, through zero to negative values (inversion). This process is brought about by the reversal of the spin moments of the electrons; it appears that Bloch's theory makes it possible to explain this process. On the other hand the magnetisation vector may rotate in relation to the principal axes of the crystal, without altering its absolute value (rotation process). The Weiss theory only considers the second of these two processes, but this is shown to lead to results which are contradicted by experiment. In the present paper the new theory is applied to ferromagnetic monocrystals, and it is shown that there is quantitative agreement with the measurements of Honda, Masumoto and Kaya, the discrepancies being at most 2 %. In a following communication the change of electrical resistance and the magnetostriction, as functions of J, will be calculated. H. N. A.

2443. Cause of the High Permeability of Permalloy Cooled in Air. K. Honda. *Zeits. f. Physik*, 67. 11–12. *pp.* 808–811, *Feb.* 25, 1931.—Concludes from the known facts that quenching in water from 600° C. leaves thermal strains in the alloy, which reduce the permeability. If, however, it is cooled quickly in air the iron, which is dissolved in the nickel, retains the high permeability which it had at the high temperature, even at room temperature. This does not take place when pure iron is treated in the same way. The highly permeable state below the critical point is not due to a change in the lattice, and must depend on an alteration in the atoms. According to the author's theory of ferromagnetism the atoms at room temperature are spherical, and thermal movements can produce no marked rotational vibrations. If the temperature rises the spherical form is lost, rotational vibrations commence, and their amplitude increases. The author has shown that the changes in permeability as the critical point is approached are caused by these vibrations. In permalloy the distorted shape is retained at room temperature, rotational vibrations are possible, magnetisation becomes easier than with the spherical atoms, and the permeability is larger than originally. H. N. A.

2444. Magnetic Characteristics of Permalloy under Internal Strain. O. v. Auwers. *Wiss. Veröff. a. d. Siemens-Konzern*, 9. 2. *pp.* 262–293, 1930.—The extensive use of permalloy renders it essential that precise data should be determined regarding the influence of internal strains in the material, the effects of longitudinal extension phenomena, and the effects of pressure. The paper is a complete experimental record of experiments both with pure permalloy wires and also with wire having the core of different alloy from the covering. The core was selected from material possessing variable extension coefficients according to known conditions under which it was placed, whilst the outer cover was always of permalloy. The influence of load and pressure was determined and illustrated in relationship to the various magnetic attributes, etc., for wires with cores of varying chemical composition and elastic coefficients, data of which are given. The relationship to μ, the maximum permeability, remanence, coercive force and the shape and area of the hysteresis curve, are determined and their values stated. Pressure has a considerable influence on the coercive force and acts in a sense opposite to that of stretch. The effects of stretching load and consequent extension and strain are fully described and noted with reference to each of the magnetic qualities named above. S. G. B.

2445. Magnetisation Temperature Curves of Iron, Cobalt and Nickel. E. Tyler. *Phil. Mag.* 11. *pp.* 596–602, *Feb.*, 1931. *Supplement.*—A previous paper discussed the theoretical significance of the spontaneous magnetisation/temperature curves for nickel. In the present paper reference is made to the modification produced in Langevin's distribution function by quantum considerations. A general expression is derived incorporating this point of view. Spontaneous magnetisation curves are constructed from this expression with values of j as $\frac{1}{2}$, 1, and $1\frac{1}{2}$. For Ni close agreement between the experimental and the theoretical curve was obtained for $j = \frac{1}{2}$, the equation taking the form $\sigma/\sigma_0 = \tanh \alpha$. The "corresponding state" curves were similarly constructed for Fe and Co from the experimental data available for these metals and were compared with the theoretical curves obtained from the classical and quantum functions, as for Ni. All three ferromagnetic metals give closely coincident curves, and over a considerable range these are coincident with the quantum curve for $j = \frac{1}{2}$, giving as above a tanh distribution. The nature and state of the elementary carriers are investigated in the light of the evidence, and it is concluded that these are electrons with independent spin moments. The electrons are not free, however, but are associated with ions as in Heisenberg's theory. The fact that the spontaneous magnetisation curve for $j = \frac{1}{2}$ is as applicable to iron and cobalt as to nickel is of great importance, since the former have certainly more than one interacting electron per atom, whilst nickel has less than one. A value of $\frac{1}{2}$ for j indicates independence of electron spins. The change of specific heat at the Curie point also seems to require an effective independence of the electron spin moments. In the ferromagnetic elements it is pointed out that it is probably the defect of electrons necessary to produce a completed configuration, rather than excess which is operative in producing the electron spin associated with ions. S. G. B.

2446. Investigation of Ferromagnetic Solids of Revolution by Means of Rotating Fields. J. Peltier. *Comptes Rendus*, 192. *pp.* 348–350, *Feb.* 9, 1931.—In testing magnetically for flaws in large masses of steel it would be advantageous to have a method, which would avoid mounting the specimen in a special lathe so as to be able to rotate it in a magnetic field. In the old method coil A was placed in the field, and the variations in the flux through it, due to flaws in the body being tested, induced currents in this coil, which made it possible to locate the flaws. The author now fixes the ferromagnetic solid of revolution, and produces a rotating field by means of three small coils with iron cores, fed with 3-phase currents from the local mains. The axis about which the field rotates coincides with the axis of the test piece. The axis of coil A, in which currents due to flaws in the test piece are induced, also coincides with the axis of the test piece. H. N. A.

2447. Electromagnetic Units. A. Blondel. *Comptes Rendus*, 192. *pp.* 124–128, *Jan.* 19, 1931.—The author contends that the O.A.S.C. (ohm-ampere-second-centimetre) system is of a less hybrid character than systems which attempt to weld together, by a common unit of power, an electromagnetic system and a mechanical system, the basic units of which are completely different. All the systems at present proposed are hybrid systems. The O.A.S.C. system is the simplest because it permits of the same basic equations as the C.G.S. system, instead of the hybrid equations of the dualistic system. The dualistic system (Q.E.S. electrical, C.G.S. magnetic) is, in the author's opinion, the most complicated and the most liable to error. If it is not decided to complete the O.A.S.C. system, the only alternative seems to be to complete one of the existing mechanical systems by electrical and magnetic units coherent with it. The author

presents his suggestions for the reform of the C.G.S. system and suggests names for the new units involved. **Errata,** *ibid.*, p. 312, Feb. 2, 1931.
R. E. N.

2448. Rationalisation of Electromagnetic Equations. A. Blondel. *Comptes Rendus,* 192. *pp.* 318–320, *Feb.* 9, 1931.—The author discusses alternative means of rationalising the basic equations of electromagnetism in relation to the value taken for the permeability of vacuum. The consequences of different alternatives as regards other units and equations are pointed out. [See also preceding Abstract.] R. E. N.

2449. New System of Units. E. Brylinski. *Comptes Rendus,* 192. *pp.* 338–339, *Feb.* 9, 1931.—The author suggests that certain statements by A. Blondel [see two preceding Abstracts] are based on a misunderstanding. To fulfil the two conditions of retaining the value of the density of water and obtaining simple values for the ratios of units, it is necessary that the unit of energy should equal 10^{10} ergs. This corresponds to the kilojoule and, among the systems resulting from it, the M.T.S.V. system is the most convenient. By adopting magnetic units in this system simplification would be effected, while leaving the way open to ultimate unification with the practical system. R. E. N.

2450. Impulse Functions. W. E. Sumpner. *Phil. Mag.* 11. *pp.* 345–368, *Feb.*, 1931.—The aim of this paper is to formulate and justify an impulse function assumed by Heaviside. Amongst the subjects discussed are, impulsive quantities, Heaviside's "Unit" and impulse functions, the impulse aspect of Fourier's theorem, the waves of Si(nct) and of its derivatives, the function $t^c/c!$, Fourier's theorem as an impulse integral, continuity of the Fourier integral, and Fourier's theorem applied to infinitesimals. J. S. G. T.

2451. Simultaneous Operational Calculus. B. van der Pol and K. F. Niessen. *Phil. Mag.* 11. *pp.* 368–376, *Feb.*, 1931.—Heaviside's operational calculus can be based upon the transformation of a given function $h(x)$ into its "image" $f(p)$ related to $h(x)$ by the equation $f(p) = p\int_0^\infty e^{-px}h(x)dx$. This relation between image and original is written $f(p) \doteqdot h(x)$ [see Abstract 2005 (1930)]. If $f(p)$ is known, then $h(x)$ can be determined as shown by Bromwich. The authors discuss a somewhat similar *simultaneous* operational calculus in which two variables x and y are treated operationally by means of two parameters p, q, defined by $1/p \doteqdot x$, $1/q \doteqdot y$, or more generally, $f_1(p) \doteqdot h_1(x)$, $f_2(q) \doteqdot h_2(y)$, where $f_1(p) = p\int_0^\infty e^{-px}h_1(x)dx$, and $f_2(q) = q\int_0^\infty e^{-qy}h_2(y)dy$. The calculus is applied to evaluate certain integrals including

$$\int_0^\infty J_n^2(u)du/u, \quad \int_0^\infty J_n(2\sqrt{\alpha\xi})J_n(2\sqrt{\beta\xi})d\xi/\xi, \quad \int_0^\infty J_n(at)J_n(bt)dt/t,$$

and to establish the orthogonality relation for Bessel functions of the same order, *viz.*: $\int_0^1 uJ_n(au)J_n(bu)du = 0$, where a and b are different roots of $J_n(x) = 0$. J. S. G. T.

2452. Heaviside's Operational Solution of a Volterra's Integral Equation when its Nucleus is a Function of $(x - \xi)$. S. Koizumi. *Phil. Mag.* 11. *pp.* 432–441, *Feb.*, 1931.—The solution of a Volterra's integral equation of the second kind with nucleus $(x - \xi)$ *viz.*, $f(x) = C\psi(x) + \int_0^\infty \psi(\xi)\kappa(x - \xi)d\xi$, where $f(x)$ is a given function of x and C is a parameter, is derived by the application of Heaviside's operational calculus, the analysis resembling that employed by van der Pol for the solution of linear differential equations [see Abstracts 3618 (1929) and 2005 (1930)]. Examples including Abel's integral equation, the operational expression of the reciprocal nuclear function, and operational solutions of linear differential equations with constant coefficients and integro-differential equations are discussed. The operational treatment of Volterra's equation can be applied to electric circuit theory. J. S. G. T.

2453. Application of Functional Operations to a Class of Integral Equations Occurring in Physics. H. Thielman. *Phil. Mag.* 11. *pp.* 523–535, *Feb.*, 1931. *Supplement.*—Generalised differentiation and integration are applied to a class of integral equations occurring in physics. The methods employed are less laborious and afford more general results than some that have been previously adopted. J. J. S.

2454. Magnetism and Electrodynamics. Irene E. Viney. *Phil. Mag.* 11. *pp.* 539–552, *Feb.*, 1931. *Supplement.*—An examination of the validity of assuming the existence of free magnetism in electrodynamical theory leads to the following conclusions. The only consistent formulation of the dynamical relations of the magnetic field is obtained by using B and not H as the magnetic force vector. Taking B as the force implies the non-existence of free magnetism. The idea that the relations of the magnetic field can be formulated as a complete analogue of the electrostatic field is wholly incompatible with a logical formulation of the relations of electromagnetic theory. G. E. A.

APPARATUS AND INSTRUMENTS.

2455. Amplifier, String Galvanometer and Photographic Camera for the Study of Action Currents in Nerves. A. Forbes, H. Davis and J. H. Emerson. *Rev. Sci. Instruments,* 2. *pp.* 1–15, *Jan.*, 1931.—The galvanometer consists of a quartz fibre 7 mm. long and 0·6 *u* diameter so adjusted as to have a natural period of 10,000 ∼ per sec. The amplifier consists essentially of six resistance-capacity coupled stages. The camera operates on the stroboscopic principle by means of a revolving mirror driven by an air turbine, and can be used at speeds up to 20 m. per sec. Full details of the construction and behaviour of the three components are given. G. E. B.

2456. Twenty-First Annual Exhibition of the Physical and Optical Societies. *Journ. Sci. Instruments,* 8. *pp.* 57–64, *and pp.* 66–69, *Feb.*, 1931.—Notes on Exhibits: "Commercial Electrical Instruments," by **A. C. Jolley**; "Laboratory Electrical Instruments," by **A. Felton**; "Wireless Apparatus," by **R. L. Smith-Rose.**

2457. Method of Comparing Ammeters at Very High Frequencies. Cecil L. Fortescue and L. A. Moxon. *Journ. Sci. Instruments,* 8. *pp.* 94–97, *March,* 1931.—Considerable difficulty has been experienced in comparing ammeters at frequencies above 1,000,000 ∼ per second with a reasonable degree of accuracy. Means of overcoming these difficulties are described and the final arrangement is reliable up to frequencies of 100,000,000 to within an accuracy of 2 %. AUTHORS.

2458. New Form of A.C. Galvanometer. H. Mukherjee and S. S. Mukherjee. *Zeits. f. Physik,* 67. 9–10. *pp.* 702–706, *Feb.* 14, 1931.—A new form of a.c. galvanometer, which is essentially a vertical type of wattmeter, is described. The galvanometer can be readily constructed for very little cost, is entirely uninfluenced by the earth's magnetic field and has a sensitivity of $3 \cdot 3 \times 10^{-8}$ ampere. [See also Abstract 624 (1931).] J. S. G. T.

2459. Ionisation Current and the Zélény Electroscope. R. Barton. *Rev. Sci. Instruments,* 2. *pp.* 118–124, *Feb.,* 1931.—The Zélény electroscope can be used not only for detecting ionisation of a gas, but also for measuring the ionisation current with an error that need not exceed 3 %. Particulars are given of the method for reaching this result. The theory is discussed. A. D.

2460. Fluxmeter with Counterbalanced Torque. F. E. Haworth. *Rev. Sci. Instruments,* 2. *pp.* 125–128, *Feb.,* 1931.—The instrument is essentially a galvanometer of very high critical damping resistance, used with a comparatively low resistance in the external circuit, in which conditions the electromagnetic damping is very effective and the moving coil, after having been deflected, will return only very slowly to its central position. The return of the system to its central position is impeded and controlled with the aid of a photoelectric cell, which introduces an opposed electromagnetic torque as and when the tendency to return manifests itself. A. D.

2461. Variation of Horizontal-Intensity Variometer Scale-Value with Temperature. G. Hartnell. *Terr. Mag.* 36. *pp.* 29–32, *March,* 1931.—In a paper on horizontal-intensity variometers the author developed the mathematical relations underlying the operation of horizontal-intensity variometers and showed how, in the case of quartz-filament suspension, the scale-value may be controlled and compensation for temperature secured by use of suitably placed auxiliary magnets [see Abstract 381 (1926)]. Further development of the formulæ shows that if too large a filament is used, change of temperature may have an appreciable effect on the scale-value. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2462. Characteristics of a New Ultra-Violet Lamp. W. E. Forsythe, B. T. Barnes and M. A. Easley. *J.O.S.A.* 21. *pp.* 30–46, *Jan.,* 1931.—The lamp is a 300-watt a.c. tungsten mercury arc known as the Type S1 lamp. The bulb (which is transparent to visible light and to ultra-violet light to about 3000 Å.) contains several cm. pressure of argon and a small amount of mercury. In operation the lamp passes about 30 amperes at 10 volts, the filament temperature being about 2200° K. The total light output is some 5760 lumens, giving an efficiency of 17·6 lumens per watt; of the total output some 20 % is emitted by the mercury arc. The various characteristics of the lamp, such as the variations of light output with voltage, spatial distribution of light, etc., are given in the form of curves. G. E. B.

2463. Radiometric and Radio-Biological Instruments at the Desert Sanatorium and Institute of Research, Tuscan, Arizona. G. E. Davis. *Gen. El. Rev.* 34. *pp.* 98–103, *Feb.*, 1931.—Two instruments are described, one a solar radiometer previously described in brief by Pettit and the other a large quartz monochromator. The solar radiometer consists essentially of an air cell containing two opposed thermocouples in front of which are two lenses mounted on a rotating disc. One lens is of quartz having a maximum transmission at 3200 Å., and the other of glass has a transmission maximum at 5000 Å. The thermocouples actuate a galvanometer, and produce continuous records on a photographic paper. The instrument is on an equatorial mounting arranged to follow the sun. The monochromator, used to investigate selective biological action of various wave-lengths, was also designed by Pettit. A quartz condensing lens concentrates the radiation into a slit, after which an arrangement of prisms produces a spectrum from which any region may be selected by means of a slit. The instrument is also on an equatorial mounting. G. E. B.

2464. Effect of Radioactive Radiations upon Euglena. W. F. G. Swann and C. del Rosario. *Frank. Inst., J.* 211. *pp.* 303–317, *March*, 1931.—An examination has been made of the rate of death of euglena cells when exposed to the α-particle radiation from radium emanation dissolved in the containing liquid. It was found that the rate of death of the cells was proportional to the strength of the dissolved emanation and to the number of live euglena cells present, a conclusion in harmony with the view that death of a cell is caused by a single impact of some sensitive region with an α-particle. The theory of the case where two impacts of the sensitive region with an α-particle are necessary to cause death has been worked out with a generality which allows for a recovery of the cells between the two impacts. It is found that the results of the experiment are inconsistent with such a hypothesis. From the experimental data, it is possible to calculate the size of the sensitive entity which when struck by the α-particle causes death to the cell. The diameter of this entity comes out about equal to that of the nucleus of the euglena cell. AUTHORS.

2465. Biological Effect of High-Voltage X-Rays. C. Packard and C. C. Lauritsen. *Science*, 73. *pp.* 321–322, *March* 20, 1931.—The problem considered is whether the effect of a definite number of r units, delivered to a suitable biological material, varies with the wave-length of the beam. A series of tests on the eggs of Drosophila show that with wave-lengths of 0·20, 0·50 and 0·70 Å. the shape of the mortality curve is independent of the quality of the beam. Recently the experiments have been extended to an X-ray beam produced at 550 kV and filtered with 6 mm. of steel ($\lambda_0 = 0{\cdot}04$ Å.). The conclusion is that between 0·04 and 0·7 Å. the biological effect of equal doses is the same. W. V. M.

2466. Action of Electric Fields of Very High Frequency on Organic Tissues. J. Saidman, R. Cahen and J. Forestier. *Comptes Rendus*, 192. *pp.* 452–454, *Feb.* 16, 1931.—Waves of approximately 15 m. wave-length were used. The resistances of parts of the human body were measured. Therapeutic applications, as a substitute for classical diathermy, indicate the superiority of this method, which avoids direct contact of electrodes on the patient. W. V. M.

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CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2467. Adsorption. J. Terwellen. *Zeits. f. phys. Chem.* 153. *Abt. A.* 1–2. *pp.* 52–67, *Feb.*, 1931.—Isotherms of the adsorption of methyl violet and methylene blue from aqueous solution by silver and nickel wires of known surface area have been determined by measurement of the concentration changes in the solution. With increase of concentration the adsorption increases rapidly to a saturation value, but at considerably higher concentrations the adsorption again increases rapidly, and the uni- —dimolecular film present at the saturation point increases in thickness until it contains 4–5 molecular layers; the adsorbed film of methylene blue on silver attains a thickness of 11 molecules. The quantity of dyestuff adsorbed per unit area at the saturation point varies with the nature of the adsorbent. By heating the silver wire at 400° C. for 2 hours its adsorptive power falls to about 60 % of that corresponding with a unimolecular layer. The production of the multimolecular layers is ascribed to the agency of the van der Waals forces. The results are in contradiction to all adsorption theories, and particularly that of Langmuir, which are based upon the unimolecular layer hypothesis. H. F. G.

2468. Adsorption. H. Schlüter. *Zeits. f. phys. Chem.* 153. *Abt. A.* 1–2. *pp.* 68–82, *Feb.*, 1931.—The adsorption of carbon disulphide and pentane vapours on glass powder and on silver has been measured at several temperatures and at pressures ranging from 5 % to 90 % of the saturation vapour pressure. Since the isotherms are of the same form for the two adsorbents the marked adsorptive power of glass for vapours cannot be regarded as due to solution taking place at the interface. In the initial stages the adsorption of CS_2 increases rapidly with increase of pressure to an ill-defined saturation point, but at higher pressures the adsorption again increases, and at an increasing rate; the adsorption at pressures above that of the saturation point conforms to the equation $N = ab^p$, where N is the molecular thickness of the layer, p the pressure, and a and b are constants. The isotherms of the adsorption of pentane are of the normal form. The layers attained with CS_2 correspond with a thickness up to 50 molecules, and with pentane, up to 35 molecules. The results do not accord with unimolecular layer theories of adsorption. H. F. G.

2469. Adsorption and Base Exchange. P. G. Nutting. *Washington Acad. Sci., J.* 21. *pp.* 33–36, *Feb.* 4, 1931.—A short discussion of such subjects as adsorption of the dark components of petroleum by filtering clays, base exchange, etc. T. H. P.

2470. Activation Energy of Adsorption Processes. H. S. Taylor. *Am. Chem. Soc., J.* 53. *pp.* 578–597, *Feb.*, 1931.—The general theory of activation energy in adsorption processes is outlined and discussed. The slow process requiring activation energy is considered as probably due to a solution process in the material and that the slowness of diffusion into the interior of the adsorbent is the rate determining factor. This, however, is not to be taken as a general explanation. The adsorptions with the higher energies of activation are in general the important ones in catalytic changes. F. J. B.

2471. Adsorption of Ions on a Surface Film. R. S. Bradley. *Phil. Mag.* 11. *pp.* 449–453, *Feb.*, 1931.—Surface films of insoluble fatty acids on water are considered to form a uniform plane array of dipoles. The potential due to this array is calculated and from it the magnitude of the adsorbed ionic layer is estimated. F. J. W.

2472. Langmuir Adsorption Isotherm. R. S. Bradley. *Phil. Mag.* 11. *pp.* 690–696, *March,* 1931.—Zeise [see Abstract 319 (1929)] has shown that Langmuir's equation, $x = c_1c_2p/(1 + c_2p)$, where x is the weight adsorbed per constant area of adsorption, p is the pressure, and c_1 and c_2 are constants, can be applied to the adsorption of gases on charcoal, and that a good agreement is obtained. There is no need, therefore, to adopt in this case the method of Polanyi, which gives a poorer agreement. In this paper the temperature variations of c_1 and c_2 are determined theoretically, and the results are found to be equivalent to those of Zeise, *viz.*, $c_1 = a_1 - b_1\mathrm{T}$ and $c_2 = 10^{a_2}/\mathrm{T}^{b_2}$, where a_1, b_1, a_2, b_2 are constants. H. H. Ho.

2473. Relationships between Phase Boundary Potential, Adsorption, Surface Tension and Particle Size. F. K. V. Koch. *Phil. Mag.* 11. *pp* 585–592, *Feb.,* 1931. *Supplement.*—The variation of potential difference with the surface tension at an interphase, as given by the Helmholtz-Lippmann equation, is used to develop the Nernst equation for the variation of electrode potential with the concentration of the ions in solution. The validity of the Helmholtz condition is discussed, and the cases when the condition is not valid are pointed out. The dependence of phase boundary potential on particle size is deduced from two methods of proof. F. J. B.

2474. Porous Disc Method of Measuring Osmotic Pressure. F. T. Martin and L. H. Schultz. *J. Phys. Chem.* 35. *pp.* 638–648, *Feb.,* 1931.—The porous disc method has been successfully applied to the measurement of the osmotic pressure of dilute KCl solutions, special apparatus having been developed for the purpose. The results tend to be high, as a result of excessive distillation from the disc; the most probable cause of error is irregularities of temperature throughout the apparatus. Distillation may be obtained in either direction with relation to the disc. H. F. G.

2475. Critical Solution Temperatures of Systems of Sulphur Dioxide and Normal Paraffins. W. F. Seyer and E. Todd. *Indust. and Engin. Chem.* 23. *pp.* 325–327, *March,* 1931.—The systems of sulphur dioxide and seven hydrocarbons of the paraffin series have been investigated. The critical solution temperature has been found to be a function of the molecular weight of the hydrocarbon. The amount of hydrocarbon soluble in sulphur dioxide at its boiling point is comparatively small. AUTHORS

2476. Microscopic and Kinematographic Study of Liesegang Rings. Suzanne Veil and L. Bull. *Comptes Rendus,* 192. *pp.* 282–284, *Feb.* 2, 1931.—The microscopical appearance of the rings during growth is described. H. F. G.

2477. Kinetic Study of Liesegang Rings. L. Bull and Suzanne Veil. *Comptes Rendus,* 192. *pp.* 682–683, *March* 16, 1931.—The growth of the Liesegang rings is studied by photographing on a continuously moving film the area immediately surrounding a drop of silver nitrate solution placed upon a bichromated gelatin film. H. F. G.

2478. Influence of Light on the Flocculation of Colloidal Solutions in Fluorescent Media. Rôle of Antioxygens. A. Boutaric and J. Bouchard. *Comptes Rendus*, 192. *pp.* 357–358, *Feb.* 9, 1931.—A continuation of previous work [see Abstract 2076 (1931)]. In order to account for the flocculating action of fluorescent media, the fluorescing power of the fluorescent substance has been measured when it is dissolved in a volume of water equal to the flocculating colloidal solution and in the presence of a quantity of electrolyte equal to that used to provoke flocculation in the colloidal solution. The results show that there is a close connection between the fluorescent power and the flocculating effect. When flocculation is produced by an electrolyte which has no antioxygen effect (*e.g.*, LiCl) the introduction of a non-electrolytic but antioxygen substance diminishes both the fluorescent power of the accelerating fluorescent substance and its flocculating power. The application of these results to therapeutics is pointed out. J. E.

2479. Photometric Measurements of Concentration and Dispersity in Colloidal Solutions. Part III. T. Teorell. *Kolloid Zeits.* 54. *pp.* 150–156, *Feb.*, 1931.—Examination of mastic sols indicates that the diminution in intensity of light traversing such sols is the result mainly of radiation (scattering). Only for very low concentrations of the sol is the intensity of such scattering proportional to the concentration. As the latter is increased, the scattering increases more slowly to reach a maximum beyond which it diminishes. For the apparatus used (Zeiss' turbidity meter) the upper limit of concentration for Kleinmann's law of proportionality between concentration and scattering is that giving a light-weakening constant of about 0·01 per mm. For nephelometric measurements of white sols, the use of light of long wave-length is recommended. [See also Abstract 2078 (1931).] T. H. P.

2480. Matter in the Film State. A. V. Blom. *Kolloid Zeits.* 54. *pp.* 210–220, *Feb.*, 1931.—Films are regarded as structures intermediate in properties to dispersoids and compact solids and are classified as unimolecular; Hardy films, not more than 10^{-4} cm. thick; and zone films, of greater thickness. The formation of solid films on liquid layers may be due to either physical or chemical processes. Film-formation by evaportion is subject to two laws: (1) the amount of the volatile component volatilised per unit of time remains constant, $y = \alpha t^n$, and (2) the velocity of film-formation at any instant is proportional to the quantity of residual volatile component, $dy/dt = \beta(a - y)$. The absolute values and the course followed by the constants α and β are regarded as characteristics for classifying the evaporation constant. Alterations in the adhesive power, for which a method of measurement is given, serve for the further classification of the processes of film-formation. T. H. P.

2481. Structure of Films. Transformations of Nitrocellulose and Structure of Cellulose Acetate and Nitrate. J. J. Trillat. *J. de Physique et le Radium*, 2. *pp.* 65–68, *Feb.*, 1931.—By using very fine collimators (0·3 mm. in diameter) X-ray diagrams may be secured of great sharpness which permit the establishment of the fact that trinitrocellulose is capable of reverting to a second crystalline form, if the nitrated cotton is dissolved in acetone and dried in such a manner as to obtain a film. The film is almost entirely crystalline if the original nitrated cotton has a proportion of 12·95 per 100 nitration; but if the nitration is less than 12 per

100, then the form is almost entirely amorphous. The results show that the phenomenon of polymorphism is quite general among cellulose and its esters. The remainder of the paper consists of a further illustrated description of the subjects studied in the first paper. [See Abstract 1024 (1931).]
S. G. B.

2482. X-Ray Studies of Cellulose Derivatives. Part VIII. Alkali-Cellulose Compounds. K. Hess and C. Trogus. *Zeits. f. phys. Chem.* 11. *Abt. B.* 5–6. *pp.* 381–408, *Feb.*, 1931.—The change in the X-ray diagram of cellulose brought about by treatment with aqueous, aqueous-alcoholic, and alcoholic sodium hydroxide has been studied. Two different products, sodium hydroxide-cellulose I and II, are obtained depending upon the strength of the alkali solution used. On drying, compound II is unchanged while I is transformed into a third substance known as sodium hydroxide-cellulose III. The swelling of cellulose in alkaline solutions is attributed to the formation of these compounds. It is suggested that while these compounds are soluble in alkali, solution is not able to occur owing to the existence of a membrane surrounding the fibres. It is pointed out that swelling does not take place in mediums in which the alkali compounds are insoluble. Cellulose forms similar compounds with potassium and lithium hydroxide which give rise to characteristic X-ray diffraction patterns.
F. J. W.

2483. Corrosion of Metals by Phosphoric Acid. P. R. Kosting and C. Heins, Jr. *Indust. and Engin. Chem.* 23. *pp.* 140–150, *Feb.* 1, 1931. —Data are given of the corrosion of 52 metals and alloys by chemically pure and crude phosphoric acid. The effects of temperature, aeration and purity of solution have been studied. Al, Ni, Sn and Zn give high corrosion rates in both types of acid. Cr offers good resistance, although increase in concentration and temperature causes increase in the rate of corrosion. Ag and Ta also offered good resistance to these acids. Pb was resistant to dilute acid, but was attacked fairly rapidly by stronger acid. Fe and FeC alloys are corroded rapidly by the pure and the dilute crude acid, but not by the concentrated crude acid. In an attempt to trace which impurity in the crude acid was inhibiting the corrosion of the iron it was shown that arsenic, hydrochloric acid, pine oil, mucilage and pyridine acted as inhibitors. In concentrated acid the corrosion rates of stainless steels suddenly increase near the boiling-point. Most non-ferrous alloys are rapidly corroded by phosphoric acid.
F. J. W.

2484. Degree of Orientation in Hard-drawn Copper Wires. W. A. Wood. *Phil. Mag.* 11. *pp.* 610–617, *Feb.*, 1931. *Supplement.*—An investigation is made of the degree of orientation across the section of hard-drawn copper wire and of the way these measurements vary as the wire is further drawn. A method is described whereby the degree of orientation may be estimated with the aid of a photometer. A core effect is found to exist. A non-oriented layer encloses an oriented core and the line of demarcation is quite sharp. The results are discussed in connection with the mechanical action of dies.
AUTHOR.

2485. Crystallisation of Copper from Molten Cuprous Chloride. V. Sihvonen. *Zeits. f. Elektrochem.* 37. *pp.* 80–82, *Feb.*, 1931.—Quincke [*Wied. Ann.* 36.270, 1889], when electrolysing molten cuprous chloride with copper electrodes placed vertically above each other, observed that when there was no current passing, copper was dissolved away from the lower, and deposited in crystals on the upper electrode. He attributed this to a thermoelectric current due to the difference in temperature. It is now shown that it is due directly to the temperature difference; the lower part of the molten cuprous chloride being hotter than the upper causes the equilibrium position of the reaction $Cu_2 Cl_2 \rightleftharpoons Cu + CuCl_2$ to shift to the right in the cooler part of the melt, where the copper crystallises out in dendrites. Any thermoelectric current actually diminishes the yield of crystalline copper. C. A. S.

2486. Arrangement of Atoms and Physical Properties of the Alloy $AuCu_3$. G. Sachs and J. Weerts. *Zeits. f. Physik*, 67. 7–8. *pp*. 507–515, *Feb.* 6, 1931.—Earlier studies of the properties of mixed crystals [see Abstract 3880 (1930)] have shown that in the case of binary alloys of copper, silver and gold that they can differ markedly from those of the pure metals. The subject has been further pursued with the alloy $AuCu_3$. It is found that this difference is less marked the more regularly the atoms of the metals are arranged on the crystal lattice. This regular arrangement can be obtained by slow cooling. F. J. W.

2487. Deformation Process and Recrystallisation Texture of Aluminium Single Crystals. W. G. Burgers. *Zeits. f. Physik*, 67. 9–10. *pp*. 605–678, *Feb.* 14, 1931.—The multiple slipping in homogeneously compressed single crystals of aluminium has been studied. Crystals so stressed have been recrystallised by heating for a short time at 600° and the relation between the initial slipping and the subsequent recrystallisation investigated. Further, the texture of such specimens has been compared with that of rolled aluminium and the differences interpreted. F. J. W.

2488. Structure Analogies of the Binary Alloys of the Transition Elements with Zinc, Cadmium and Aluminium. W. Ekman. *Zeits. f. phys. Chem.* 12. *Abt. B.* 1–2. *pp*. 57–78, *Feb.*, 1931.—Fe-Zn, Co-Zn, Ni-Zn, Rh-Zn, Pd-Zn, Pt-Zn and Ni-Cd alloys, examined by X-rays, show the γ-brass structure for compositions corresponding, or very nearly so, to the valency electron: atom ratio 21 : 13 [see Abstract 40 (1930)], provided that the valency of the transition element is taken as nil. The Fe-Zn, Co-Zn and Ni-Zn alloys show this phase for compositions extending respectively over 77–81, 78–85 and 81–85 (atomic) % of zinc. Co-Zn alloys containing 73–78 (atomic) % of zinc, under certain conditions of tempering, contain also a phase possessing the β-manganese structure. Co-Al alloys of compositions including that giving a valency electron : atom ratio of 3 : 2 (cobalt treated as of nil valency) exhibit the β-brass structure. Atomic volume calculations show that all these alloys are formed with marked contraction. [See Abstract 840 (1930).] C. A. S.

2489. Extraction of Germanium and Gallium from Germanite. W. I. Patnode and R. W. Work. *Indust. and Engin. Chem.* 23. *pp*. 204–207, *Feb.* 1, 1931.—A method has been developed for the extraction of germanium from the sulphide ore germanite. Weights of ore of the order of 1 kg. can be treated at a time. The process consists of three steps. The dry powdered ore is treated with chlorine at 350° C. and the resulting volatile chlorides of germanium, arsenic, silicon and sulphur distilled over. The mixture of the chlorides is then fractionally distilled. The impure germanium tetrachloride is then hydrolysed and the suspension so obtained saturated with chlorine and fractionally distilled, giving a product which is spectroscopically pure. The yields are between 85–90 % of the total germanium in the ore. F. J. W.

2490. Carbon-Black Flame. W. B. Wiegand. *Indust. and Engin. Chem.* 23. *pp.* 178–181, *Feb.* 1, 1931.—The basic difference between carbon black and lampblack is defined in terms of the method of collection, and possible causes of the unique properties of impingement black are discussed. By reference to two types of carbon-black flames—round and flat—the conception of "combustion quotient" (ratio of flame surface s to flame volume v) is developed and applied to variations in flame size and shape and to draught. The position of the impingement surface, the effect of flame shape, of gas flow, and of position of channel are briefly discussed in relation to the quality and quantity of black obtained. Factors of importance in large-scale operations are mentioned. T. H. P.

2491. Luminous Stationary Flames. S. T. Minchin. *Inst. Petroleum Technologists, J.* 17. *pp.* 102–120, *Feb.*, 1931.—The present work describes an examination of the utility of the Kewley and Jackson method of evaluating the burning of kerosines in which a figure called the "tendency to smoke" is determined. It is shown that this figure is a valuable and informative test and directly proportioned to the complexity and composition of petroleum mixtures. The "tendency to smoke" is also a fundamental property dependent on molecular structure and, furthermore, is capable of application in the solution of practical refinery and disposal problems. J. K.

2492. Flame Speeds in the "Inflammation" and "Detonation" of Moist Carbonic Oxide-Oxygen Mixtures. W. A. Bone and R. P. Fraser. *Roy. Soc., Proc.* 130. *pp.* 542–551, *Feb.* 3, 1931.—Flame speeds in these mixtures have hitherto been mainly confined to the $2CO + O_2$ mixture. The present experiments extend the data over the whole explosion range. The initial phase of "inflammation" is succeeded by an oscillatory movement, which may end up in "detonation," and flame speeds in both these phases are measured, two methods, electrical and photographic, being employed as in a previous paper [see Abstract 2946 (1927)]. In the inflammation stage the maximum speed mixture is found to be one containing about $3 \cdot 5\ CO + O_2$. In mixtures containing argon, helium and nitrogen respectively, maximum speeds are obtained with $4CO + O_2 + 3 \cdot 8\ A$, $5CO + O_2 + 3 \cdot 8\ He$ and $4CO + O_2 + 3 \cdot 8\ N_2$. A tube of diameter 2·5 cm. is found to give a higher speed of detonation than one of diameter 1·3 cm. Photographs and curves are given, with a description and sketch of the apparatus employed. T. B.

2493. Degenerate Explosions and Induction Periods. N. Semenoff. *Zeits. f. phys. Chem.* 11, *Abt. B*, 5–6. *pp.* 464–469, *Feb.*, 1931.—The induction periods observed with explosive processes and with slow reactions are discussed from the standpoint of the chain theory of explosion. T. H. P.

2494. Study of Chemical Reactions from Potential Energy Diagrams. A. R. Olson. *Faraday Soc., Trans.* 27. *pp.* 69–76, *Feb.*, 1931.—The specific discussions of cis-trans isomerism (the simplest examples of molecular rearrangement) emphasise the fact that the problems of the chemist and physicist are essentially the same, even though the words used to describe them differ. Heats of transition become identified with potential energy differences, rates of reaction with probabilities of transition and intensities of spectral lines, the effects of catalysts and of solvents with perturbation of the energy curves, steric hindrance with moments of inertia and potential energies, etc. H. H. Ho.

2495. Kinetics of Reduction of Cuprous Oxide. Part I. F. J. Wilkins. *Chem. Soc., J. pp.* 330–335, *Feb.*, 1931.—The reduction of cuprous oxide is studied at low pressures under such experimental conditions that the area of the copper-cuprous oxide interface is effectively constant, and the water formed during the reduction is removed instantly from the reaction vessel. The rate of the reduction is given by $\log_e p_0/p = kt$, where p_0 is the initial pressure of hydrogen, and p the pressure at time t, k being a constant. This result is explicable on the assumption that the rate of the reduction is dependent upon the rate at which hydrogen can evaporate from the adsorbed layer at the cuprous oxide surface into the body of the oxide. The heat of activation of the reaction is 18,000 cal., which, on the above hypothesis, is to be identified with the heat of evaporation of adsorbed hydrogen into cuprous oxide. The earlier work [see Abstract 660 (1931)] on the oxidation of copper at low pressures has been extended to pressures of the order of 10^{-2} mm. H. H. Ho.

2496. Kinetics of Oxidation of Copper: Establishment of Sorption Equilibria. F. J. Wilkins. *Phil. Mag.* 11. *pp.* 422–432, *Feb.*, 1931.—The general kinetic equations are developed for the oxidation of copper in a closed system. The most general equation is too complicated to be applied to the experimental results. A slightly simpler case is dealt with in which it is assumed that a sorption equilibrium exists between the oxide film and the gas phase. The equation obtained is found to provide an accurate description of the results under the requisite conditions. Further, it is shown that the time taken for a sorption equilibrium to be established increases with the activation of the surface. This result finds a ready interpretation if it is assumed that the adsorbed oxygen is able to diffuse laterally. The results are considered in their relation to catalysis and the theory of adsorption at the gas/solid interface. AUTHOR.

2497. Thermal Decomposition of Nitrous Oxide. H. C. Ramsperger and G. Waddington. *Nat. Acad. Sci., Proc.* 17. *pp.* 103–105, *Feb.*, 1931.—The authors point out that the relatively simple molecule, N_2O, definitely decomposes monomolecularly. The rate is first order at high pressures, but the rate constant falls off at lower pressures. The rate as a function of the pressure follows an equation required by an earlier theory of Rice and Ramsperger [see Abstract 3008 (1927)]. A table is given of recognised monomolecular reactions, giving the pressure and temperature ranges which have been studied, the constants in the rate-constant equation, $K_\infty = Ae^{-Q/RT}$, and the number of classical squared terms required by further theories of Rice and Ramsperger to fit the data. J. K.

2498. Photochemical Reaction between Nitric Oxide and Mercury Vapour. W. A. Noyes, Jr. *Am. Chem. Soc., J.* 53. *pp.* 514–526, *Feb.*, 1931.—The rate of pressure decrease in a system consisting of Hg vapour and NO illuminated with the resonance radiation of mercury has been studied. The reaction follows the equation $dp/dt = K_1(p - \frac{1}{2}p_0)$. Studies were also made of the quenching of the fluorescence of Hg vapour by NO. It is probably to be ascribed to two processes. Various mechanisms for the activation process are discussed. Probably a NO molecule in a high vibration state of the normal electron level is produced by collisions of the second kind. J. E.

2499. Optical Dissociation of Mercury Halides. V. Kondratjew. *Zeits. f. phys. Chem.* 11. *Abt. B.* 5–6. *pp.* 470–474, *Feb.*, 1931.—On the assumption that the optical dissociation of mercuric halides is represented by the scheme, $HgX_2 + h\nu \rightarrow HgX + X'$, an interpretation for the absorption spectra of these molecules is derived. This interpretation, together with various spectroscopic and thermochemical data, permits of the calculation of the heat changes accompanying the reactions, (1) $Hg + X = HgX$ and (2) $HgX + X = HgX_2$ with an accuracy of within a few calories. The values obtained are: (1) 27, 20 and 12 and (2) 79, 65 and 53 cal. respectively for Cl, Br and I. With these results as a basis, the question of the valency of the Hg atom is discussed. T. H. P.

2500. Variation of Extinction Coefficient of Solutions with Temperature. Part II. A. K. Bhattacharya and N. R. Dhar. *J. Phys. Chem.* 35. *pp.* 653–655, *Feb.*, 1931.—The extinction coefficients of solutions of neocyanin, ferric thiocyanate, sodium cobaltinitrite, and mixtures of solutions of sodium malonate and iodine, sodium tartrate and iodine, citric and chromic acids, lactic and chromic acids, citric acid and potassium permanganate, and tartaric acid and potassium permanganate increase appreciably as the temperature is raised. This phenomenon, which furnishes a partial explanation of the frequent increase observed in the quantum yield with rise of temperature, may be explained by the change of the degree of hydration of the solutes at the higher temperatures [see also Abstract 1359 (1929)]. T. H. P.

2501. Directed Valency in Polyatomic Molecules. J. C. Slater. *Phys. Rev.* 37. *pp.* 481–489, *March* 1, 1931.—The interactions of atoms in polyatomic molecules are described qualitatively. Particular attention is paid to atoms of the types of F, O, N, C, where the valencies come from p electrons. Directional effects are discussed, namely, that the two valences of O, and the three of N, tend to be mutually at right angles, and the four of C have tetrahedral symmetry. Numerous examples are given, from the structure of metals and of organic and inorganic compounds. Mathematical treatment is postponed until a later paper. [See also Abstract 2726 (1930).] AUTHOR.

2502. Orbital Valency. J. H. Bartlett, Jr. *Phys. Rev.* 37. *pp.* 507–531, *March* 1, 1931.—The interaction of two atoms, each with one $2p$ electron, is studied by a method similar to that used by Kemble and Zener [see Abstract 2684 (1929)]. An atomic wave function whose radial part is of the form const. $re^{-kr/2}$ (that is, with no nodes) is used. Complete potential energy curves are obtained for the twelve possible states, which are $^1\Delta_g$, $^3\Delta_u$, $^1\Pi_g$, $^1\Pi_u$, $^3\Pi_g$, $^3\Pi_u$, $^1\Sigma_u^-$, $^3\Sigma_g^-$, two $^1\Sigma_g^+$, and two $^3\Sigma_u^+$. The most stable states are $^3\Sigma_u^+$ (lowest) and $^1\Sigma_g^+$, which arise from $m_{la} = 0$ and $m_{lb} = 0$, and in which there is the maximum overlapping of charge. The states with least overlapping of charge are those where $m_{la} = \pm 1$ and $m_{lb} = \pm 1$, resulting in $^1\Delta_g$, $^3\Delta_u$, $^1\Sigma_g^+$, $^1\Sigma_u^-$, $^3\Sigma_g^-$, $^3\Sigma_u^+$, which are all repulsive. The Π states lie in between and are attractive. The present work gives precision to the ideas of Heitler on orbital valency, yields a positive exchange energy integral for the lowest states, and may be taken as supporting the conceptions of Slater about directed valency [see preceding Abstract]. AUTHOR.

2503. Studies in Coordination. Part III. Energy of Coordination. F. J. Garrick. *Phil. Mag.* 11. *pp.* 741–744, *March*, 1931.—In preceding papers [see Abstract 4145 (1930)] an attempt was made to explain the formation of ion hydrates and ammino compounds on an electrostatic basis, whereby with the aid of certain assumptions as to their repulsive force constants the (negative) potential energies ϕ were calculated; $-\phi$ is now called the energy of coordination. In this paper the previous values obtained for $-\phi$ are compared with other better established energy quantities, *e.g.*, lattice energies, examples of the hexammine-chlorides $[Ni(NH_3)_6]Cl_2$ being considered. H. H. Ho.

2504. Quantum Theory of Chemical Combination for Polyatomic Molecules. W. Heitler and G. Rumer. *Zeits. f. Physik*, 68. 1–2. *pp.* 12–41, *March* 11, 1931.—The principle of the quantum valency theory is applied to polyatomic molecules. The interaction of the atoms is investigated by the methods of Slater, Bloch and Born. The interaction energy is a function of reciprocal integrals and is treated as in the case of diatomic molecules [see Abstract 2976 (1930)]. For each two atoms there is a reciprocal integral which depends only on the nature of these atoms and their distance apart. The energy is found from the problem of a perturbation matrix H_σ, where σ = the spin component to the right. The matrix H_σ may in general be reduced to the partial condition $H_{s\sigma}$ where s is the amount of the total spin. A method of reduction is given. The results are summed up for a series of examples. The consequences of the theory are in general in agreement with the chemical facts. J. J. S.

2505. Theory of Solution of Metals. Part II. M. Straumanis. *Zeits. f. phys. Chem.* 153. *Abt. A.* 1–2. *pp.* 107–111, *Feb.*, 1931.—It is shown that the linear relationship of the difference effect to the current density is only quantitative if the increase in solution velocity and the increase in " nobleness " of the potential are introduced into the formula. If the effect is treated as purely a resistance phenomenon, curves are obtained instead of the linear relationship. The possible causes of the increase of " nobleness " of the potential are to receive further consideration. F. J. B.

2506. Cuprous-Cupric Equilibrium in Copper Sulphate and Perchlorate Solutions. E. Heinerth. *Zeits. f. Elektrochem.* 37. *pp.* 61–76, *Feb.*, 1931.—The reaction $Cu^{\cdot\cdot} + Cu \rightleftarrows 2Cu^{\cdot}$ is investigated in acid copper sulphate and perchlorate solutions between the temperatures of 20° and 60° C. In the sulphate solutions the ratio (cupric normality)$^{\frac{1}{2}}$/cuprous normality is independent of the concentration over a considerable range. In perchlorate solutions the equilibrium ratios are uncertain owing to the reduction of the perchlorate ions by cuprous salts. From the results with the sulphate solutions the heat of the reaction was 18·8 cal. between the temperatures of 20° and 60° C. The normal potential of the reaction $Cu \rightarrow Cu^{\cdot}$ at 25° C. was + 0·525 volts. The production of spongy deposits depends upon polarisation as pointed out by Foerster. F. J. B.

2507. Single Potential of Iron and Steel Electrodes. H. Endo and S. Kanazawa. *Tohoku Univ., Sci. Reports,* 20. *pp.* 124–139, *March,* 1931. *In English. Report No.* 261 *from the Research Inst. for Iron, Steel and Other Metals.*—The authors have measured the single potential of pure iron electrodes, such as the single crystal, electrolytic iron in various conditions, and Armco iron, various precautions against possible sources of errors being taken. Besides this, the electrode potentials of pearlitic steel of various carbon contents of from 0·1 to 1·4 % were also measured. The main object of the present investigation was to study the effect of the grain boundary and also that of a slight strain on the electrode potential. In the latter case, a large single crystal was gently sawn by hand into two pieces and one of them was slightly strained; these two were then used as differential electrodes. The grain boundary always increased the electrode potential and the strained electrode was more electro-positive than the annealed one. AUTHORS.

2508. Quinhydrone Electrode. Parts I and II. J. L. R. Morgan. Olive M. Lammert and Margaret A. Campbell. *Am. Chem. Soc., J.* 53. *pp.* 454–469 *and* 597–604, *Feb.,* 1931.—The reproducibility of the quinhydrone electrode in $0\cdot1N\mathrm{HCl}$ is studied under varying conditions and with a large number of different electrodes. The results show that the quinhydrone electrode can be reproduced with great precision, agreement to less than 0·00001 volt being obtained. The effect of nitrogen upon the quinhydrone electrode in $0\cdot1N\mathrm{HCl}$ is to increase the ease with which the results are reproduced. Electrodes prepared with nitrogen were found to acquire a definite equilibrium potential much more rapidly than those prepared in air. F. J. B.

2509. Effect of Breadth of Junction on E.M.F. of a Concentration Cell. G. Scatchard and T. F. Buehrer. *Am. Chem. Soc., J.* 53. *pp.* 574–578, *Feb.,* 1931.—Measurements of the e.m.f. of hydrochloric acid concentration cells showed that the e.m.f. was increased a few hundredths of a millivolt when the liquid junction was made very thin. This increase is considered to be due to the change of temperature at the boundary by the heat of mixing of the two solutions. F. J. B.

2510. Electrode Potential and the Solvent. Solvation Activity Coefficient. F. K. V. Koch. *Phil. Mag.* 11. *pp.* 579–585, *Feb.,* 1931. *Supplement.*—The thermodynamics of the transference of an ion from a vacuum to a solution of the ion of specified concentration in a given solvent are considered, and the idea of the solvation activity developed. Nernst's electrolytic solution tension is explained in terms of the activity. The normal potentials, solvation potentials and element potentials are calculated for a number of ions in water. The solvation activity coefficients for a number of kations and anions are calculated. The Walden formula, which states that the solvation activity coefficients of all ions in a given solvent should be the same and proportional to the cube of the dielectric constant of the solvent, is shown to be without experimental support. F. J. B.

2511. Conductivity of Strong Electrolytes. R. Dufour. *Soc. Franç. Élect., Bull.* 1. *pp.* 128–139, *Feb.,* 1931.—In a previous paper [see Abstract 691 (1931)] the thermodynamic phenomena, lowering of freezing point, rise of boiling point, reversible e.m.f.s and activity were considered. The conductivities of solutions are now developed from the point of view of the Debye theory. An attempt is made to explain the conductivity

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of strong electrolytes, and to remove the anomalies which exist in the published data. F. J. B.

2512. Conductance of Electrolytes. Part III. Design of Cells. G. Jones and G. M. Bollinger. *Am. Chem. Soc., J.* 53. *pp.* 411–451, *Feb.*, 1931.—The observation that the ratio of the resistances of two conductance cells when filled with a common solution and measured with an a.c. bridge is not independent of the specific conductance of the solution used is confirmed, but the use of a superior bridge results in simplification of the curves. With an unshielded bridge designed to avoid conductance and capacitance, measurements have been made of the phase angle between the current and the voltage in conductance cells, this angle depending on the frequency, the resistance being measured, the degree of platinisation, and the dimensions of the cell. It is found that, with cells of the type commonly used, there is a capacitative shunt between parts of the cell of opposite polarity, this making the measured resistance lower than the true resistance of the electrolyte between the electrodes. The error due to such shunts differs in sign from that due to polarisation, and also in being increased by increase of the frequency and of the resistance measured; it varies as the square of the capacitance in the shunt and as the first power of the resistance in the shunt, but is independent of the degree of platinisation. New cells are designed in which close proximity of parts of opposite polarity is avoided. These can be used at frequencies and resistances so high as to make errors due to polarisation negligible without introducing errors due to capacitative shunt, and seem to give results reliable within 0·01 %. [See also Abstract 1252 (1930).] T. H. P.

2513. Conductivity Measurements in Methyl Ethyl Ketone and in Acetone. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 153. *Abt. A.* 1–2. *pp.* 1–51, *Feb.*, 1931.—Methyl ethyl ketone having a specific conductivity of 5×10^{-8} mho has been prepared; its density at $t°$ C. is expressed by $d_t = 0{\cdot}82737\,(1–0{\cdot}0012635t)$. The conductivities at 25° C. of solutions of a large number of salts of primary, secondary and tertiary amines, quaternary ammonium bases, and inorganic acids in methyl ethyl ketone, and, in a few cases, in acetone, have been determined at dilutions up to 10^5 litres. The square-root law is applicable to nearly all the solutions. The salts have been grouped into two classes, *viz.*, strong and weak, of which the latter are regarded as incompletely ionised. The influence of structure on the strengths of the electrolytes is discussed; the degree of ionisation of the tetra-alkylated ammonium bases increases with increase of the molecular weight of the kation, and, as in other solvents, the same rule is applicable to the alkali metal salts. For a given kation, the strengths of the salts decrease in general in the order picrate, iodide, perchlorate, nitrate, bromide and chloride, which resembles the order in acetonitrile solution. The Kohlrausch law of independent ionic mobilities, and the Stokes-Walden law relating the conductivity at infinite dilution with the viscosity, are valid for both strong and weak electrolytes in methyl-ethyl-ketone solution. The mobilities and degrees of solvation of the ions have been calculated. As in general, the mobility is greatest for the largest ions, the solvation numbers are greater for the kations than for the anions, and are rather lower in methyl-ethyl-ketone solution than in acetone, a result, probably, of the greater molecular volume of the former solvent. H. F. G.

2514. Electrochemistry of Magnesium. S. Bodforss. *Zeits. f. phys. Chem.* 153. *Abt. A.* 1–2. *pp.* 83–106, *Feb.*, 1931.—The potential of magnesium is a function of the H-ion concentration of the solution, first becoming more negative and then becoming more noble as the H-ions increase in concentration. The potential is dependent also on the nature of the anion; thus, at constant pH, it becomes increasingly negative in the series acetate, tartrate, citrate. Addition of neutral substances which readily form complexes, such as pyrocatechol, renders the potential less noble; ammonium salts, carbon dioxide and carbon monoxide act similarly. Since a marked alteration in potential is often produced by such small additions that no appreciable influence on the concentration of the divalent magnesium ion can result, it is assumed that the process determining the potential is not expressed by the reaction $Mg \rightarrow Mg^{\cdot\cdot} + 2\ominus$, and as a working hypothesis, the reaction $Mg \rightarrow Mg^{\cdot} + \ominus$ or $2Mg \rightarrow Mg_2^{\cdot\cdot} + 2\ominus$ is assumed. Other facts, such as the effect of motion and the anodic behaviour of magnesium, appear to point in this direction.

T. H. P.

2515. Electrolytic Dissociation. K. Fredenhagen. *Zeits. f. phys. Chem.* 152. *Abt. A.* 5–6. *pp.* 321–379, *Feb.*, 1931.—The experimental foundations on which, with the help of theoretical assumptions the electrostatic theory of electrolytic dissociation is based are criticised and the theory concluded to be untenable. Thermodynamic consideration indicates a close connection between the solvent and ionising powers of the solvent, any theory which does not reflect such connection being either incomplete or false. It is shown to be possible to develop a theory of electrolytic dissociation without assuming dielectric action of the solvent. This theory starts from the assumption that the chemical affinities holding the atoms together in their compounds are not completely saturated by the formation of the molecules of such compounds, the atoms being still able to exert certain forces of chemical affinity on other elements which are sufficiently near and with which they are able to react. This assumption leads to the conclusion that the condition of the ions in the solution as regards their charges is similar to that of the atoms in their polar compounds. The assumptions made furnish explanations for a number of facts which are either contradictory to the electrostatic theory or are interpretable by this theory only by means of special postulates. Among these facts are: the varying behaviour of strong and weak electrolytes, which leads to the assumption of the formation of associated ion-pairs in the case of strong electrolytes; the dissociation of the pure solvent and of fused salts; and the pronounced specific solvent power of typical solvents such as water, liquid ammonia and liquid hydrogen fluoride.

T. H. P.

2516. Electroendosmosis of Organic Liquids against a Glass Surface. F. Fairbrother and M. Balkin. *Chem. Soc., J. pp.* 389–403, *Feb.*, 1931.—Electroendosmosis of fourteen pure organic liquids and water through a diaphragm of sintered Jena Gerate glass-powder was studied. It was found that pure benzene and carbon tetrachloride exhibit no measurable electroendosmosis, ether was negatively charged towards the glass and the remaining liquids and water were positively charged. The connection between the dipole moment of the molecules and the electroendosmosis is discussed. F. J. B.